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URD RESOURCE ROOM

Continuing Assessment of the Effects
of Padre Isles Development on Ecology

Prepared for P.I. Invest. Corp. by
ECO systems Management

Box 6

PAIS

A Total Systems Approach To Environmental Problems

CONTINUING ASSESSMENT OF THE EFFECTS OF
PADRE ISLES DEVELOPMENT ON ECOLOGY

Prepared for

PADRE ISLAND INVESTMENT CORPORATION
Corpus Christi, Texas

PAIS

ECOSYSTEMS management

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A part of Coastal Ecosystems Management, Inc

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Progress Report 1

CONTINUING ASSESSMENT OF THE EFFECTS OF PADRE ISLES DEVELOPMENT ON ECOLOGY

Prepared for

PADRE ISLAND INVESTMENT CORPORATION
Corpus Christi, Texas

Prepared by

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21 September 1974

TABLE OF CONTENTS

Page

LIST OF TABLES iii

LIST OF ILLUSTRATIONS iv

INTRODUCTION 1

  Data Collection 2

RESULTS 5

  Water Quality 11

    Hydrogen-ion concentration (pH) 12
    Dissolved oxygen (DO) 14
    Nutrients (NO_2^-, NO_3^-, PO_4^{-3}) 16
    Coliform bacterial counts 19
    Chlorinity (salinity) 21
    Calcium and magnesium concentrations 21
    Trace metals 24
    Biological oxygen demand (BOD) 24
    Rainfall and weather 28
    General water quality summary 28

  Aquatic Organisms 31

    Bacterial populations 33
    Plankton organisms 34
    Benthos (small bottom animals) 37
    Nekton and larger invertebrates 43

  Sediments 48

  Terrestrial Organisms 49

    Birds 50
    Mammals 53
    Pest Control 55
    Plant communities 55
    Soils and ground water quality 60

COMPARISONS OF DATA FROM THE PADRE MARINE STUDY WITH PRESENT DATA FROM PADRE ISLES 61

  Water Quality 62

TABLE OF CONTENTS (continued)

Page

Aquatic Organisms 64

Terrestrial Organisms 68

DISCUSSION OF IMPACT OF PRESENT CONSTRUCTION ON NATURAL ATTRIBUTES OF PADRE ISLES 70

Water Quality 70

Biological Quality 71

Terrestrial Plant Cover 73

Overall Impact Rating 76

SUMMARY 78

REFERENCES CITED 82

APPENDIX I. Description of Station Locations and Tables 1 - 11
APPENDIX II. Soil Reports
APPENDIX III. Water Quality Testing Reports

LIST OF TABLES

Table		Page
1.	Water quality data--January and September 1973	AI-3
2.	Water quality data--February and August 1974	AI-7
3.	Percents sand, silt, and clay as determined by sediment analyses--1973	AI-11
4.	Percents sand, silt, and clay as determined by sediment analyses--1974	AI-12
5.	Benthic invertebrate populations	AI-13
6.	Nektonic and epibenthic organisms collected in waters associated with Padre Isles Development, September 1973	AI-14
7.	Nektonic and epibenthic organisms collected in waters associated with Padre Isles Development, February and August 1974	AI-18
8.	Plankton counts for three localities at Padre Isles--1973	AI-34
9.	Plankton counts for three localities at Padre Isles--1974	AI-36
10.	List of vascular plants collected from Padre Isles, August 19-23, 1974	AI-39
11.	Coliform bacterial counts on bottom water samples	AI-51
12.	Weather summary--Padre Island National Seashore	30
13.	Disturbance factors measured at Padre Isles aquatic sampling stations	32
14.	Plankton populations at selected stations	36
15.	Counts of fish and large invertebrates from trawl and seine catches, 1973-1974	45
16.	List of birds observed at Padre Isles--August 1974	52
17.	List of rodents trapped or observed on Padre Isles--1974	54
18.	Plant quadrat weights--Padre Marina, February 1974	59
19.	Water quality comparison--Padre Isles with Padre Marina	63
20.	Faunal comparisons--Padre Isles with Padre Marina	68
21.	Impact ratings for two year's development--Padre Isles	78

LIST OF ILLUSTRATIONS

Figure | Page

1. Map of completed construction by August 1974 with station locations occupied during August 1974 field trip 3
2. Map of Padre Isles' development as it was in 1973, with locations of original stations 7
3. Development plan for Padre Isles 9
4. pH values at all stations by sampling periods 13
5. Dissolved oxygen at all stations by sampling periods 15
6. Nitrate plus nitrite concentrations at all stations by sampling periods 17
7. Orthophosphate concentrations at all stations by sampling periods . 18
8. Coliform bacterial counts on bottom water samples for all stations by sampling periods 20
9. Chlorinity values for all stations by sampling periods 22
10. Calcium concentrations at all stations by sampling periods 23
11. Magnesium concentrations at all stations by sampling periods . . . 25
12. Copper concentrations at all stations by sampling periods 26
13. Biological oxygen demand (BOD) levels at all stations by months for three localities 27
14. Rainfall at Padre Isles by months from January 1973 through July 1974 29
15. Phytoplankton and zooplankton populations at selected stations . . 35
16. Benthic invertebrate counts per 1/25 m^2 sample at all stations by sampling periods 39
17. Number of benthic taxa per 1/25 m^2 at all stations by sampling periods 40
18. Diversity indices (Shannon-Weaver) for benthos at all stations by sampling periods 42
19. Comparisons of the larger animal's populations at selected trawl stations 46
20. All stations locations for Padre Marina study 58
21. Padre Isles water quality values graphed against Padre Marina water quality values for three habitats 65
22. Biological data comparisons between Padre Isles and Control stations outside of development 66

INTRODUCTION

An ongoing survey of the general environmental health of Padre Isles has now entered its second year of study. A complete inventory of resources of the Padre Isles Development, before most of the housing has been constructed, was carried out between February 1973 and February 1974. These data and a discussion of their relevance to the protection of natural resources are contained in a major report by Bryant, Alderson, Parker, and Smith (1973). At the suggestion of Padre Island Investment Corporation (PIIC), it is the intent of Coastal Ecosystems Management, Inc. (C.E.M.) to monitor changes in the environment for the next three years, as further construction and changes in land use within the development take place. The aforementioned study serves as a solid baseline from which to assess affects of continued human pressure on a relatively sensitive ecosystem.

Previous studies involved an inventory of approximately 4,000 acres of northern Padre Island during the winter season of 1973 and again in early fall of 1973. A full-scale survey of plant and animal resources and water quality was made both times. A series of 15 aquatic stations were sampled for plankton, bottom animals, and fish; trap lines were ran for a census of small rodents; and birds and flowering plants censuses were carried out. These data were used to create maps of animal and plant communities. Sediment and soil analysis were performed and descriptions made of climate, geological, and special natural features.

A preliminary report was drafted on the basis of data collected during the first trip in January 1973. A final annual report was completed in November

1973 after a second trip in September of that year was made to resample all parameters that were measured in January (Bryant, et al., 1973). Comparisons were made between environmental conditions existing in the winter and in the early fall. Ratings were calculated as to environmental impact of various development activities (grading, construction, dredging, and planting). Other changes could be attributed to differences in plant and animal populations and diversity between summer and winter. In order to assess accurately the impact of development, one must separate out changes within the ecosystem which result from natural variation of climate, hydrography, and living populations. Natural ranges were established both from literature surveys and from environmental measurements taken over the past 19 months. Some changes have been wrought in land use and construction since inception of this study. These consist of the dredging of many new residence canals, construction of additional houses, multi-family residences and other structures in the northern areas, completion of a bridge over Packery Channel, and construction of a hotel and condominium along the beach. The present stage of construction, shown as structures completed by August 1974, is given on Figure 1. Station locations for the August 1974 trip also are shown on this map.

Data Collection

The same techniques used to sample animal and plant species on previous trips were used to inventory Padre Isles this year. The 1974 sampling trips were carried out on 16-17 February and 14-15 August. The February trip was arranged for end of winter conditions and the August trip to be representative of the hottest summer period. The techniques and methods are described in detail in the 1973 annual report (Bryant, et al., 1973). Some changes in approach to assessment were added on the February 1974 trip, because of the need for specific information on the new marina area. Data were obtained for a

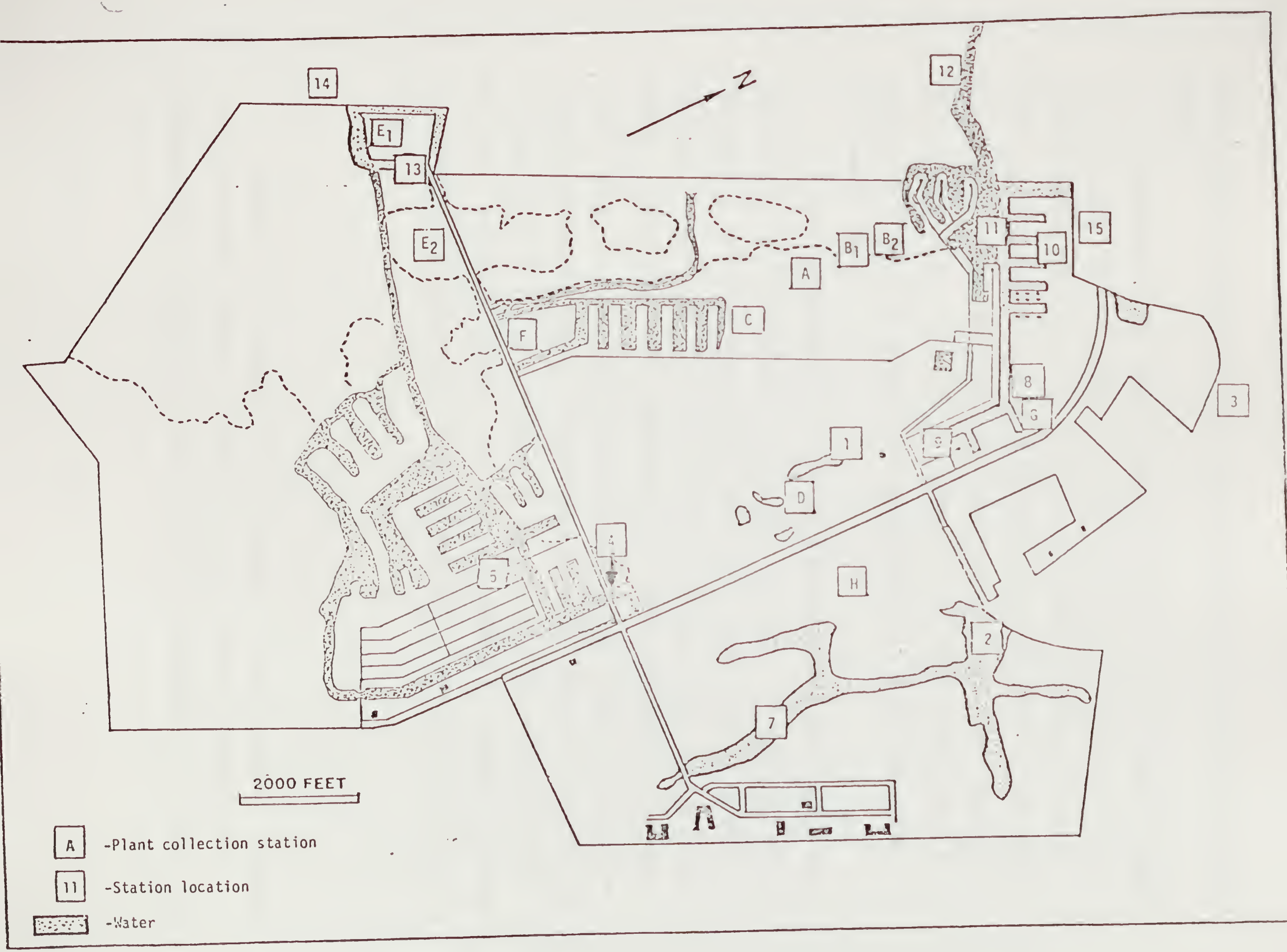

Figure 1. Map of completed construction by August 1974 with station locations occupied during August 1974 field trip.

special study of the marina site--in order to assist PIIC in obtaining a dredging permit.

In addition to the usual 15 sampling stations in aquatic habitats, another 40 stations were occupied within the marina site and in control areas outside the development boundaries. For the first time, general biological and water quality of project habitats could be compared with those outside of the project but subjected to the same general climatological variations. This "baseline" study of wildlife and fisheries habitats within and outside of Padre Isles (Parker, 1974) furnishes an excellent and comparable set of data for rating environmental change.

The same techniques for biological and hydrographical assay used on the Padre Isles study were used also on the marina project. One difference was in the method of collecting data from the small oyster reefs along the northern perimeter of Padre Isles (in Packery Channel). Because a grab sample will not work on a living shell reef, hand collections of shells and oysters were made. A small survey of resident and breeding birds of the small spoil islands in the vicinity was also carried out. Methods and results of studies on the marina site are given in Parker (1974). The types of data collected during the August 1974 trip were identical to previous trips with the exception of the devotion of more time to terrestrial communities, and a more complete collection of flowering plants.

RESULTS

In order to rate changes in the environment of Padre Isles during the past six months (since the September 1973 survey), major construction changes in development must be assessed and demonstrated. The development as it stood in the

beginning of the study is shown on Figure 2 and the projected plan for total development is given on Figure 3. Note that canals had been excavated only as one series in the northwestern corner and around the proposed utility complex in the southwestern corner. The only structures completed at that time were homes and a small sewage treatment unit around the residence canals (Galleon Bay area), the Padre Island Country Club and golf course, two condominiums, an apartment complex and a hotel (The Resort Hotel) on the beach, a small sewage treatment unit on Packery Channel (station 7), a motel (an old one near station 6), and the project construction headquarters (south of station 6).

Since the September 1973 set of data were collected, several more structures have been completed--the Red Carpet Inn and another large condominium on the beach, a bridge over Packery Channel, and a major multi-family housing complex south of the Galleon Bay area. Additional canals have been dredged and a number of paved roads have been made between the construction headquarters and the site of the utility complex (Fig. 1). During early 1974 the majority of new construction took place adjacent to the Galleon Bay area; an area of minimum environmental impact since all of it is on reclaimed spoil areas created from dredging residence canals. The new hotel and condominium were also constructed on newly created land surfaces behind the seawall on the beach. To our knowledge no new construction took place on native plant communities, as all vegetation destroyed by the recent building was growing on recolonized spoil or fill. Summer construction was concentrated in dredging new canals, constructing roads, and bulkheading new residence areas south of Galleon Bay.

New canals and canal extensions were dredged which could have an effect on both general water quality and aquatic fauna and flora. For this reason three stations were occupied in newly constructed canals. These effects, if any, will be pointed out in the changes in values of ecological data which have occurred

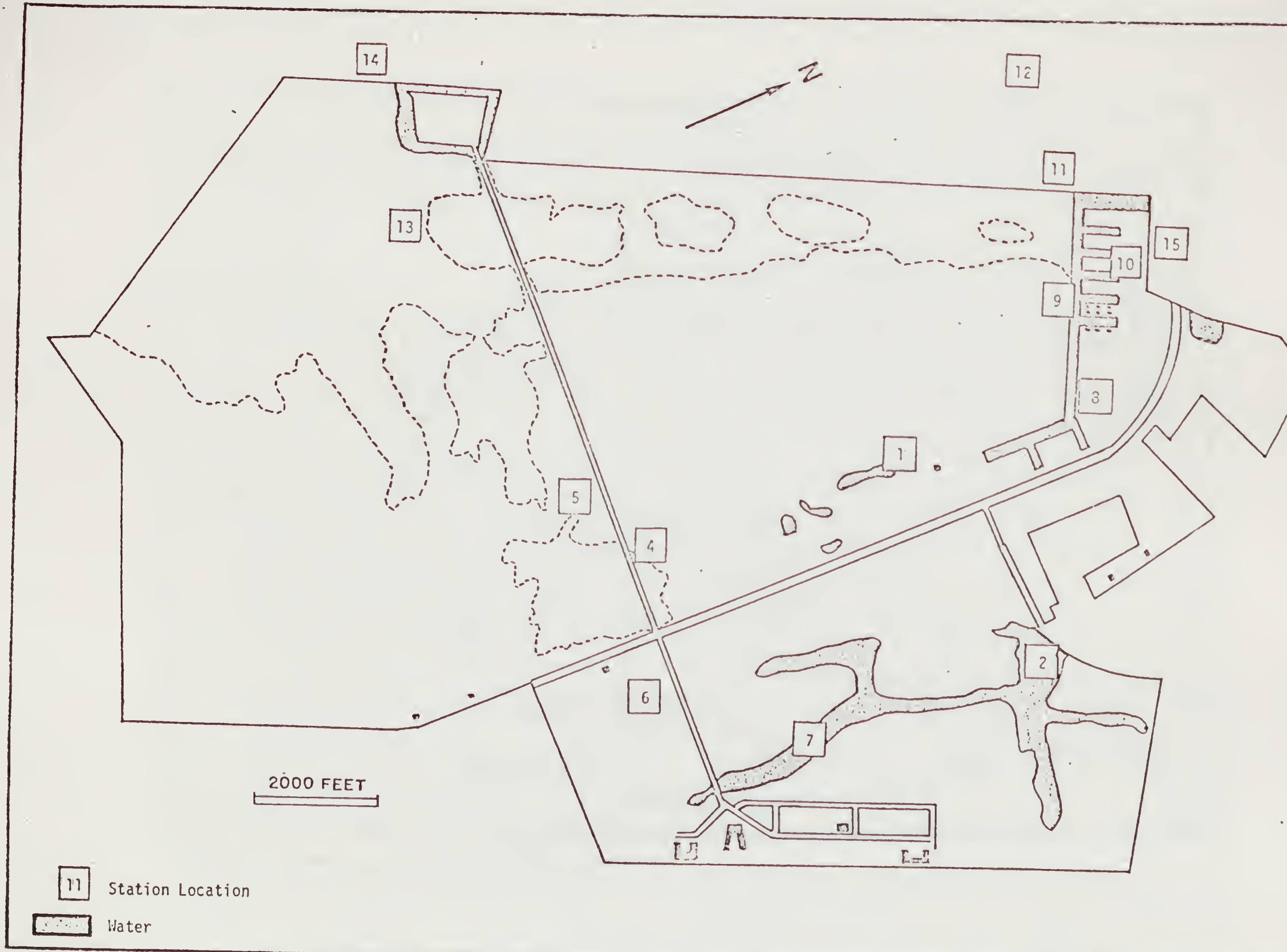

Figure 2. Map of Padre Isles' development as it was in 1973, with locations of original stations.

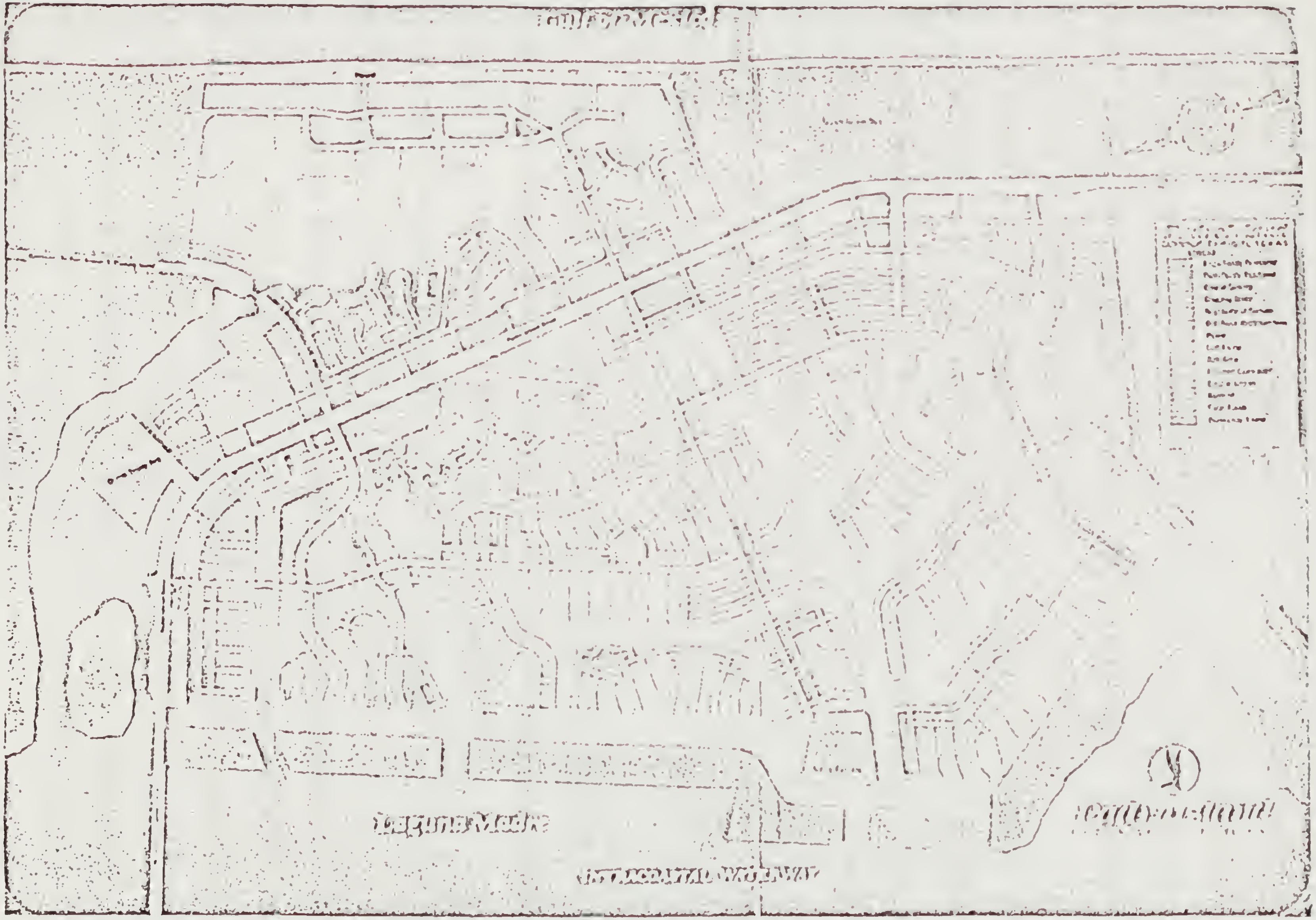

Figure 3. Development plan for Padre Isles.

at stations taken in the recently impacted areas. In order to examine the data for such changes, one must first compare the data in Table 1 (January and September 1973 water quality data) with those in Table 2 (February and August 1974 water quality data). Additional information for comparison can be found in Table 3 (1973 sediment data), Table 4 (1974 sediment data), and Table 5 (benthic invertebrate count and density indices).

Another method of comparison for biotic changes in the Padre Isles area is to examine the 1973 and 1974 trawl data (Tables 6 and 7) and plankton data (Tables 8 and 9) taken from season to season and between Padre Isles and the central area to the north of the proposed Padre Marina site. Finally, differences in sedimentation or possible increases in silt and clay between January 1973 and February 1974 should indicate the effects of increased dredging activity within the development. Sediment samples were not collected at all stations in August 1974.

Few flowering plants were in evidence in February 1974, but a whole new suite of forbs were observed in August. Collections were made on both native range and reclaimed land. Table 10 indicates species taken in various areas and serves to show differences and similarities between vegetational cover on undisturbed and reclaimed lands within the development.

Striking differences were observed between the February and August bacterial (coliform) populations in the regular 15 aquatic station areas. Such differences are to be expected as bacteria are extremely temperature dependent. It was quite unexpected, however, to find a drastic drop in coliform counts in the Gulf Club Lake which receives sewage effluent from Galleon Bay. Apparently, the present treatment is extremely effective. Tabulated coliform counts over the past two years are given in Table 11.

Because of their length, Tables 1 through 11 are placed in Appendix I. Verbal description of station locations also can be found in Appendix I.

It is not necessary to discuss background information as to climate, geology, archaeology, soils, economics, et cetera, as these subjects were adequately covered in the first report (Bryant, et al., 1973). These factors are more or less stable and change only over long periods. These long term changes will be reexamined again at the end of the five-year period. The results discussed in this report will be confined to the observable short-term changes that have taken place only during the past 19 months.

Water Quality

Standard water quality data have been routinely collected from the Golf Club Lake through the efforts of the personnel of the Padre Island Country Club--in particular Mr. David Gregg. These data are needed to monitor water quality, as lake waters are used to water the fairways and greens. As these variables are not all significant in determining environmental conditions influencing marine flora and fauna, slightly different parameters were measured at the marine stations. The primary source of fresh water for the development is the Golf Club Lake, and much of this water eventually finds its way into the residence canals through the shallow (three feet below the surface and five feet above sea level) ground-water channels. Those parameters not filterable through ground percolation may eventually affect residence canals. There is also some indication that the recycled ground water and sewage effluent is responsible for slightly lowered salinities in some residence canals. When salinities rise above 39 $^{0}/oo$ to 40 $^{0}/oo$ in the adjacent Laguna Madre, many organisms may find the canals to be an environmental haven.

In order that differences from season to season and year to year between water quality in the various parts of Padre Isles can be made more comprehensible, a series of small graphs have been created for each important water quality variable measured. Nine sets of graphs depicting curves for January-September 1973 and February-August 1974 values at all 15 C.E.M.'s aquatic sampling stations are given on Figures 4 through 12. Data graphed are for pH, dissolved oxygen, nitrites plus nitrates, phosphates, coliform bacterial counts, chlorinity, calcium concentration, magnesium concentration, and copper concentration. Two more graphs were prepared from data supplied by David Gregg: Figure 13, BOD's (biological oxygen demand) measured at the Golf Course Lake and in Packery Channel from February 1973 through June 1974; and Figure 14, rainfall in inches by months for 1973 and 1974 at the Padre Island Country Club.

Hydrogen-ion concentration (pH)

An examination of these simple line graphs reveal a number of interesting facts concerning water quality within various habitats inside Padre Isles and in the waters surrounding it. One indication of water quality is pH (acidity or alkalinity). Normal pH for fresh water is between 6.8 and 7.4, while normal sea water is from 7.8 to 8.2. Measurements of pH taken at each aquatic station during the four field trips are shown on Figure 4. Note that during September 1973 and February 1974 pH values were identical and in a normal range for estuaries; even at Station 5 (a recently dredged residence canal) where in February a pH value of 7.4 was measured. All other values ranged from 7.85 to 7.90. On the other hand, considerable variation was found between stations occupied in January 1973 and August 1974. One value is suspect; an 8.9, at the Golf Club Lake in August 1974, which is much too high for fresh water. Relatively high values in August for other stations can be accounted for by the fact that hypersaline conditions predominated. Only one value taken within the residence canals showed a

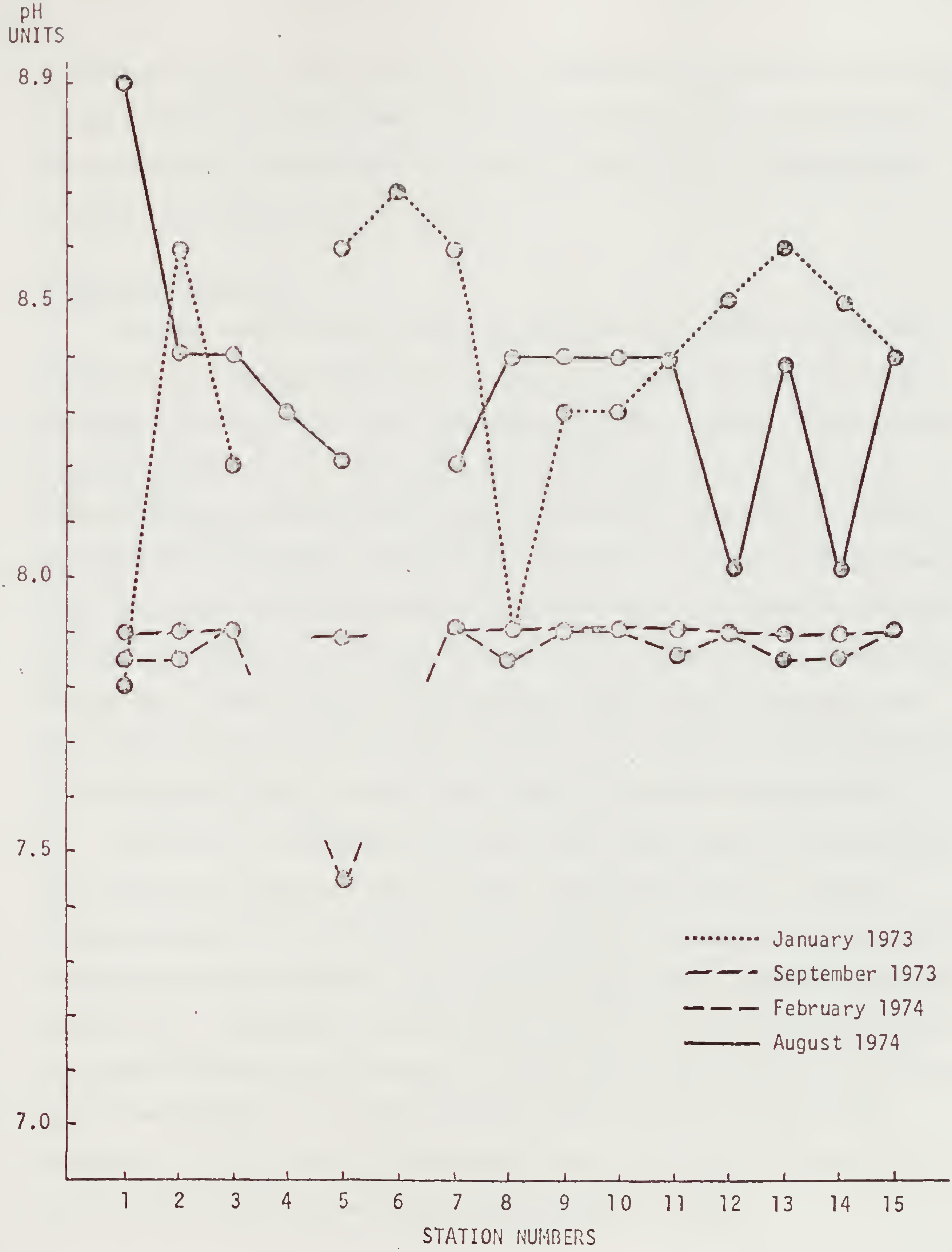

Figure 4. pH values at all stations by sampling periods.

disturbance factor. The pH at Station 8 in Galleon Bay adjacent to the package sewage treatment plant was lower than others in January 1973. At this time, a break was present in the sewer line running to the Golf Club Lake producing slightly acid conditions in the canal.

Dissolved oxygen (DO)

Another parameter which indicates relative water quality is dissolved oxygen (DO). A healthy aquatic system normally requires levels above 4 ppm, the lower limit set by the Texas Water Quality Board. Plots of DO for the four sampling periods are given on Figure 5. Oxygen levels are high and at all stations except at Station 9 the levels were more than acceptable during the January 1973, and February and August 1974 periods. The very low figure (nearly zero) for Station 9 in August 1974 is very significant. In August of that year, Station 9 was moved to the end of the canal that terminates at the Padre Island Country Club. This location is the farthest inland and has no outlet, thus circulation must be assured to insure a healthy environment. On the other hand, all other water quality variables were normal at Station 9 in August 1974.

Data for DO in September 1973 show a different picture of water quality. Only two values (Stations 2 and 3 in outer Packery Channel) are above the minimum acceptable limit set by the Texas Water Quality Board. All values within residence canals were below 2 ppm, considered barely high enough to sustain most aquatic life. Low oxygen values are typical of hot summer salt waters, thus the low values were not taken seriously. However, waters were twice as salty and had higher temperatures in the summer of 1974, yet values were high and life-supporting. The fact that active dredging took place in most of the canals during the 1973 summer sampling period may explain these low values.

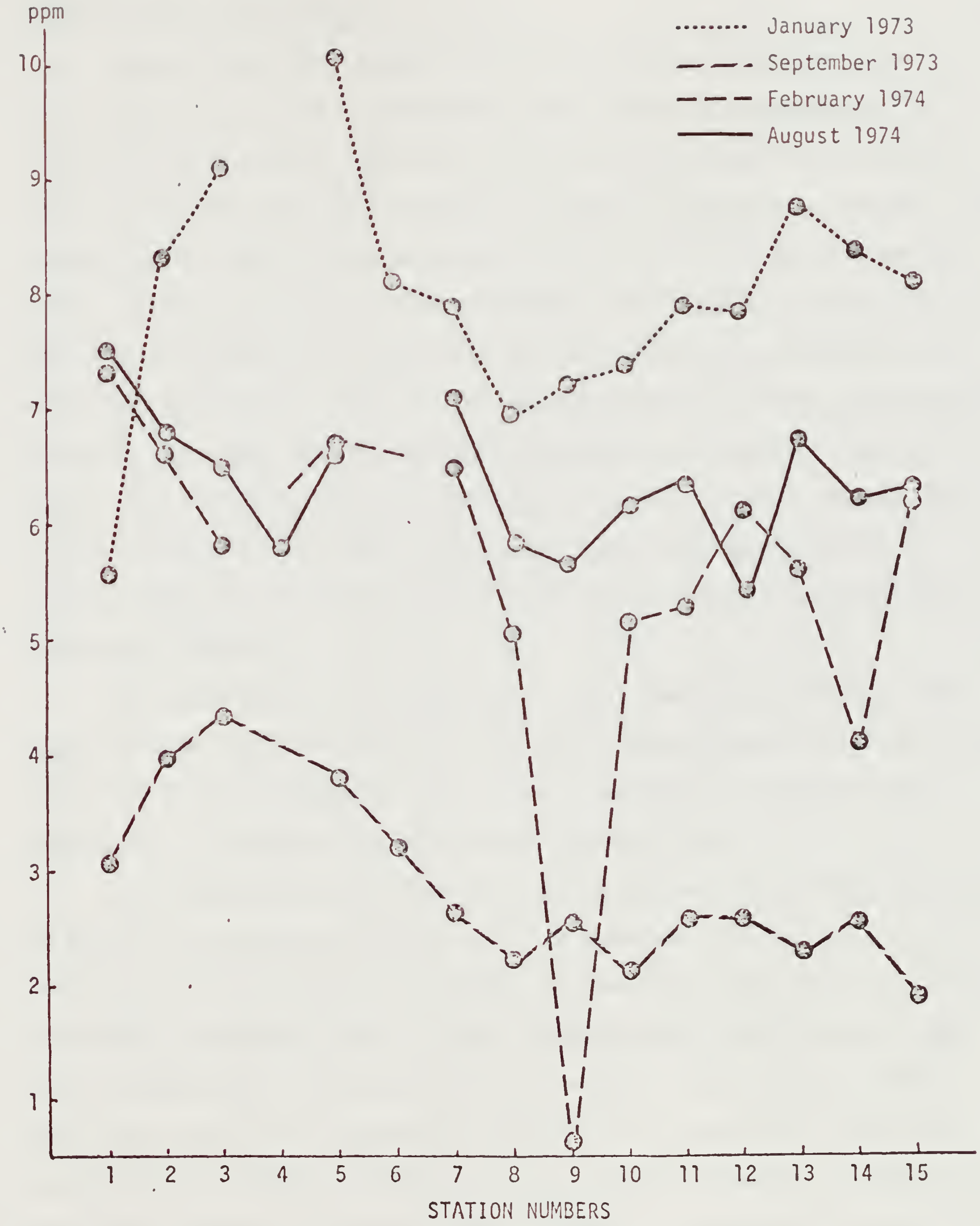

Figure 5. Dissolved oxygen at all stations by sampling periods.

Nutrients (NO_2^-, NO_3^-, PO_4^{-3})

Nutrient substances (aquatic fertilizers--nitrites, nitrates, and phosphates) may also give an indication of the health of a water body. Too little nutrients causes a reduction in plant life which supports the animals, while too much may cause overproduction of plants and depletion of oxygen. An examination of nitrogen compound concentrations for the four sampling periods (Fig. 6) shows some interesting relationships. For instance, very low values were found in February 1974, with only one value above 2 ppm at Station 13, near the planned utility complex. For most estuarine areas these values would be too low to support sustained phytoplankton growth. However, it should be mentioned that high phytoplankton populations characterized all stations with the exception of the vicinity of Station 13. When high populations of phytoplankton occur, nutrient concentrations become reduced, being used up in production of plants.

Two very high nitrate values in the August sampling were found at the Golf Club Lake and at the outfall of the small sewage treatment plant near the hotel complex near Packery Channel. These values are to be expected since nitrates are not removed from waters which discharge there.

The other nutrient substance monitored was orthophosphate (PO_4^{-3}), values of which are illustrated on Figure 7. It is immediately evident that 1973 values are twice as high as 1974 values, and that there seems to be no seasonal significance to average levels. Higher values for 1973 could relate to higher runoff (rainfall was very high in 1973 and very low, up to August, in 1974). High runoff brings fertilizer-derived phosphate into the system. Even though considerable variation is evidenced by the four seasonal curves, all values are relatively low and do not suggest that problems from eutrophication are likely

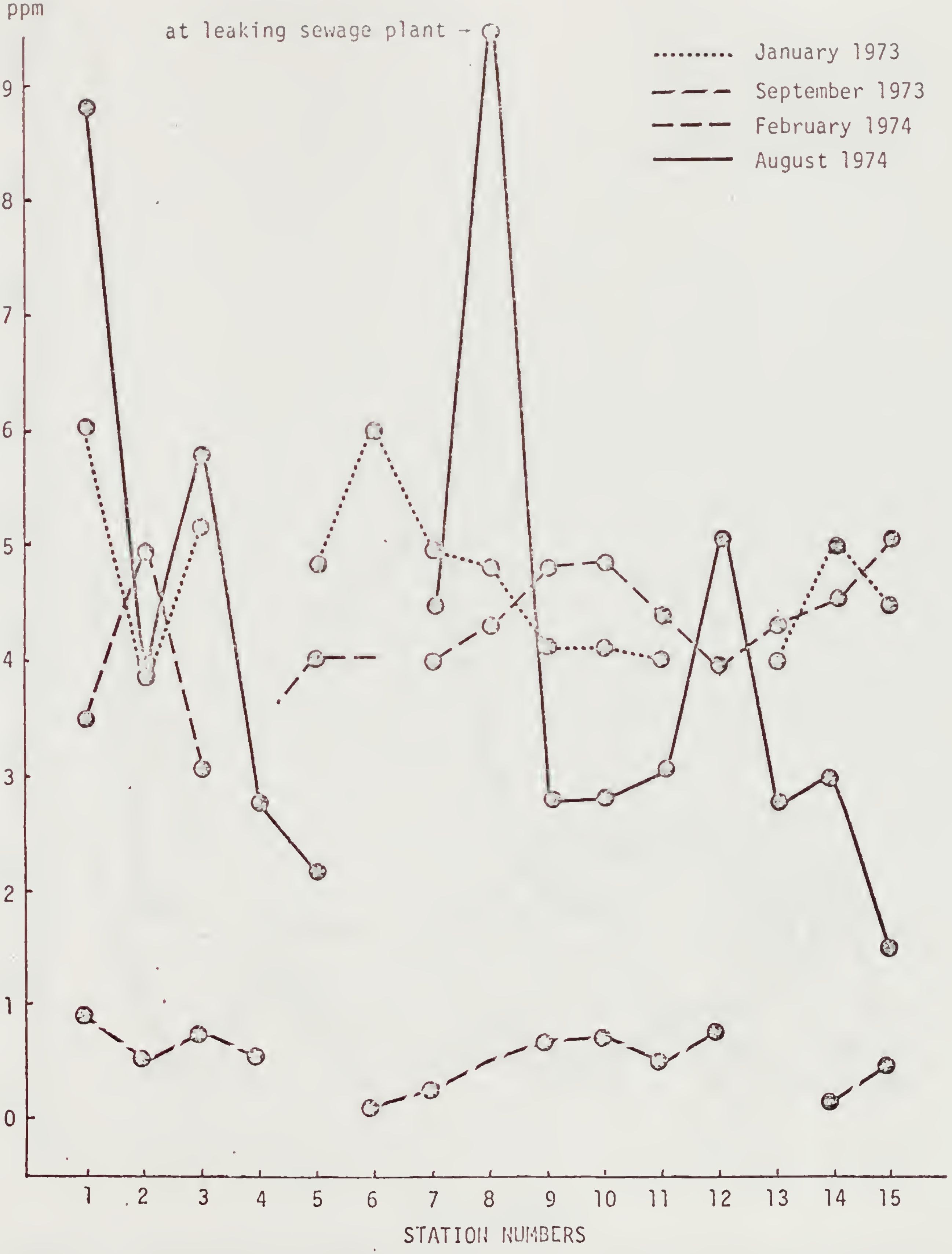

Figure 6. Nitrate plus nitrite concentrations at all stations by sampling periods

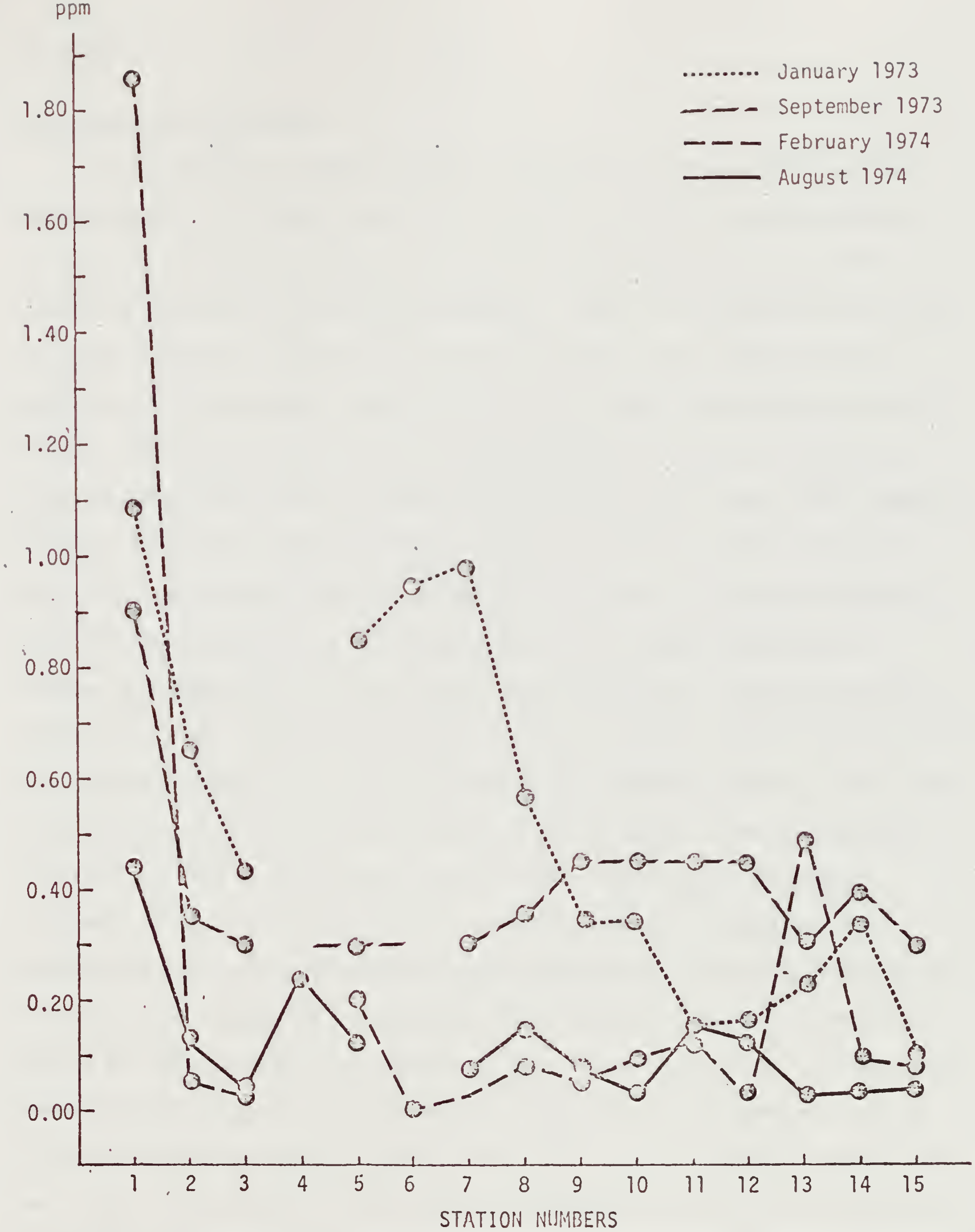

Figure 7. Orthophosphate concentrations at all stations by sampling periods

to occur.

Coliform bacterial counts

Water quality in terms of public health is a function of the presence and abundance of coliform (intestinal) bacteria. In that most water bodies within Padre Isles are utilized for some form of recreation, it was felt necessary to measure the coliform abundance. Plots of the numbers of coliform bacteria per 100 ml of water are given on Figure 8. Those bodies of water adjacent to or affected by human activities are easily discerned through high counts. Very high counts at the Golf Club Lake and Station 4 (a transient pond behind a package sewer treatment facility) marks the January 1973 sampling period. Freshwater seepage at that period was evident at Stations 2 and 7. Low counts at the other stations in January 1973 and all stations in February 1974 are characteristic for winter conditions. As these organisms are temperature dependent, it is not surprising that counts at the land and human activity related stations are higher in summer. Low counts denote high salinity at Stations 9 through 15. It is well known that coliform bacteria do not live well in high salinities. One obvious fact can be derived from the curves on Figure 8 and that is that there is considerable leakage from the sewage treatment facility at Station 7 near the hotel-condominium complex. High coliform counts well over the limit suggested by public health departments as safe for human recreation were found during all sampling periods. Some steps should be taken to repair the leaks that were observed by C.E.M.'s survey crews. Guests were playing in the water only a few feet from where sewage water was flowing out onto the ground and into the water. Coliform counts from this water were over 1,000 cells per 100 ml. Levels recommended by the Texas Water Quality Board (1973) for contact recreation is 70 coliforms per 100 ml for Corpus Christi Bay.

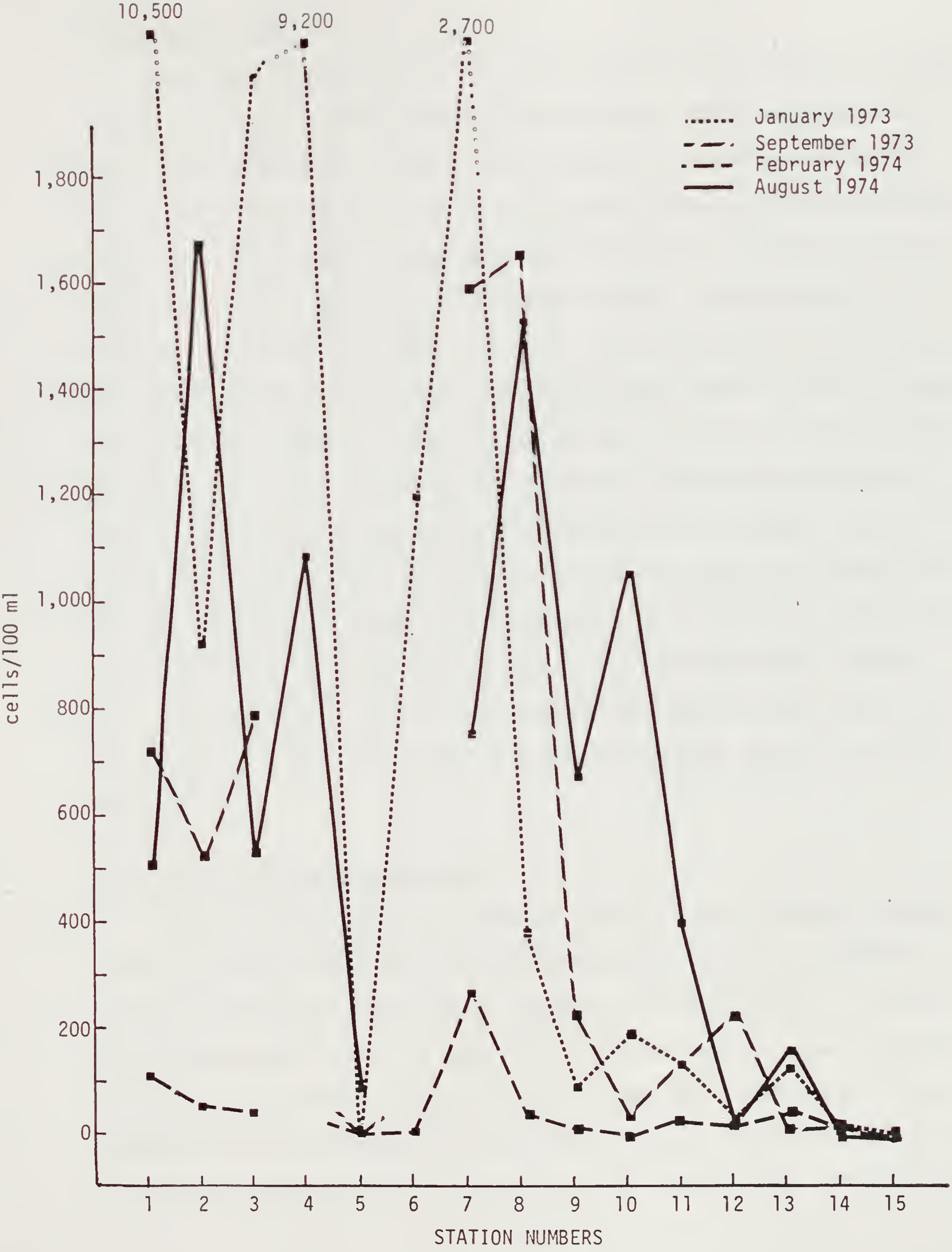

Figure 8. Coliform bacterial counts on bottom water samples for all stations by sampling periods.

Chlorinity (salinity)

Chlorinity or the more commonly used conversion term *salinity* is important in influencing aquatic animal and plant distribution. Observed chlorinities which can be converted to salinity values through the equation--salinity in $^{0}/oo$ = 1.806 X chlorinity in $^{0}/oo$--are given and plotted by station and season on Figure 9. These graphs reveal that major differences in chlorinity exist between winter and summer of 1973 and summer of 1974. Normal chlorinities for seawater range between 16 $^{0}/oo$ and 18 $^{0}/oo$. Note that during 1973 and early 1974, chlorinities were well below this range at most stations; while in August 1974, chlorinities were well above normal except at Station 14. Salinities at Stations 3, 10, 11, and 15 were all hypersaline, showing excess evaporation. Stations occupied within the innermost residence canals were much lower, suggesting that ground-water seepage is effective in lowering salinities to a level more compatible for most marine organisms. Chlorinities in the Golf Club Lake are similar at all times and typical of a slightly brackish freshwater pond. Low chlorinity at Station 6 in January 1973 denoted that a sample was taken at a freshwater pond; now dried up, as evidenced by no data for other sampling periods.

Calcium and magnesium concentrations

Calcium and magnesium concentrations are related to hardness qualities of water and also reflect the chlorinities--assuming constancy of composition of sea water (derived only from the sea and not from inland areas). In general, calcium concentration curves (Figure 10) closely follow the curves for chlorinity on Figure 9. Low calcium values were found at the Golf Club Lake and at the freshwater pond first sampled. The only unusually high calcium value was found at Station 13 (near the utility complex site) in February 1974. No explanation

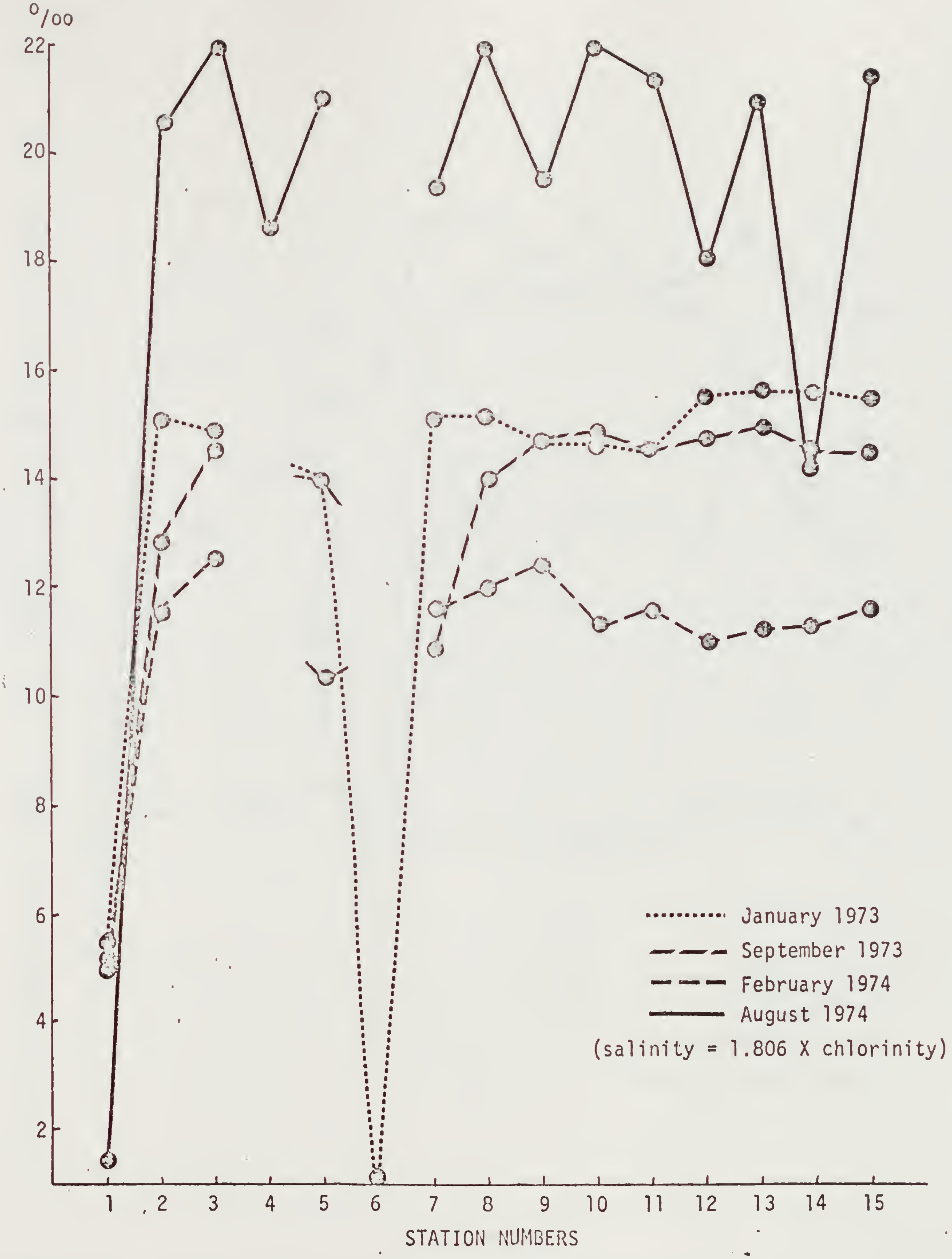

Figure 9. Chlorinity values for all stations by sampling periods.

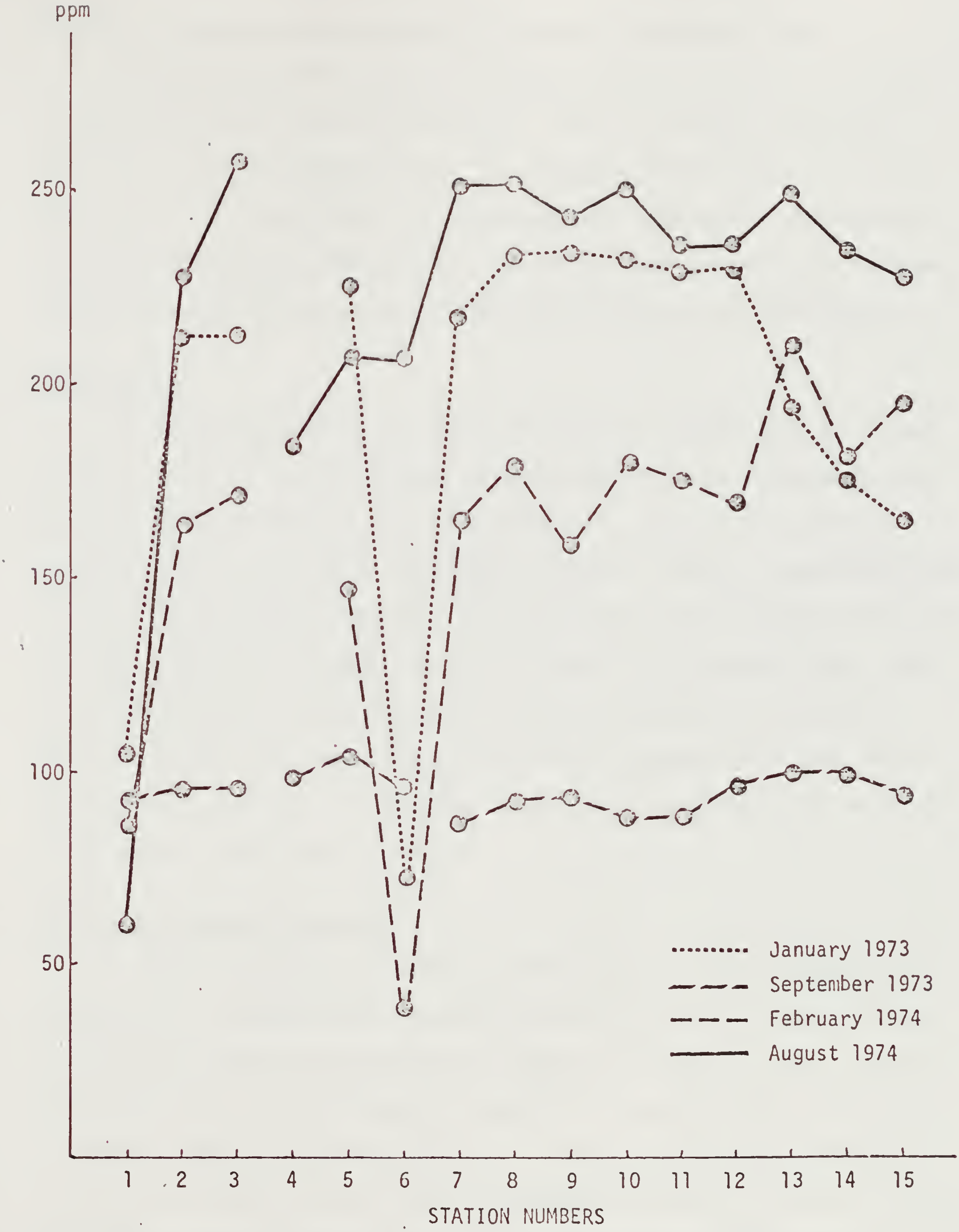

Figure 10. Calcium concentrations at all stations by sampling periods.

for this relatively high value can be offered at the present time.

Magnesium concentrations at all sampling periods (Figure 11) likewise resemble those for calcium and chlorinity. Again low values characterize Stations 1 and 6 (freshwater areas). Very high magnesium values in general were measured in August 1974. As salinities were very high, high magnesium values can be expected. Magnesium concentrations are so high in the adjacent Laguna Madre that gypsum crystals (magnesium sulphate) often forms there.

Trace metals

Although determination of copper, iron, and zinc were made at various times, only copper has consistently been measured as it is representative of most of the trace metals found in sea water. All three metals in minute concentrations are utilized in biological systems; although, large amounts may be poisonous, particularly copper. All copper values are plotted on Figure 12, and none are shown to be over 3 ppm, and the majority are under 1.5 ppm. Zero values characterize fresh water, while highest values are correlated with higher salinities, showing a direct relationship between salinity and trace metals in this region. It is readily apparent that copper does not enter this system from a local source.

Biological oxygen demand (BOD)

A major criterion for determining water quality is BOD or biological oxygen demand. Although such measurements were not made by C.E.M.'s survey crew, monthly values were obtained by Clement O. Williams, Jr. P.E. from the Golf Course Lake, Packery Channel, and Galleon Bay canals. These values are plotted on Figure 13. Note that the Golf Course Lake values are plotted on a different scale and are nearly four times higher than those in Packery Channel and at Galleon Bay. BOD's in both of the marine areas are very low and

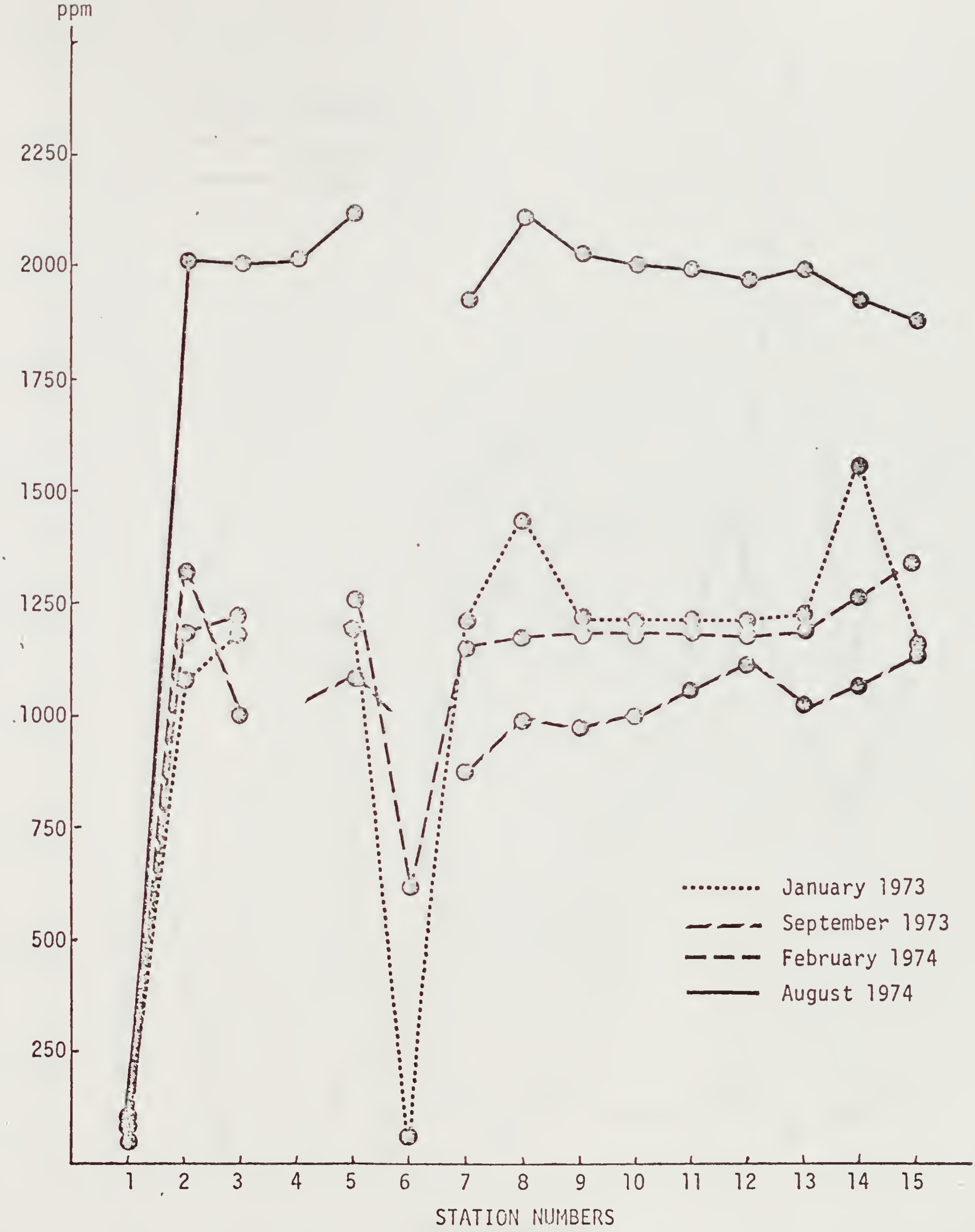

Figure 11. Magnesium concentrations at all stations by sampling periods.

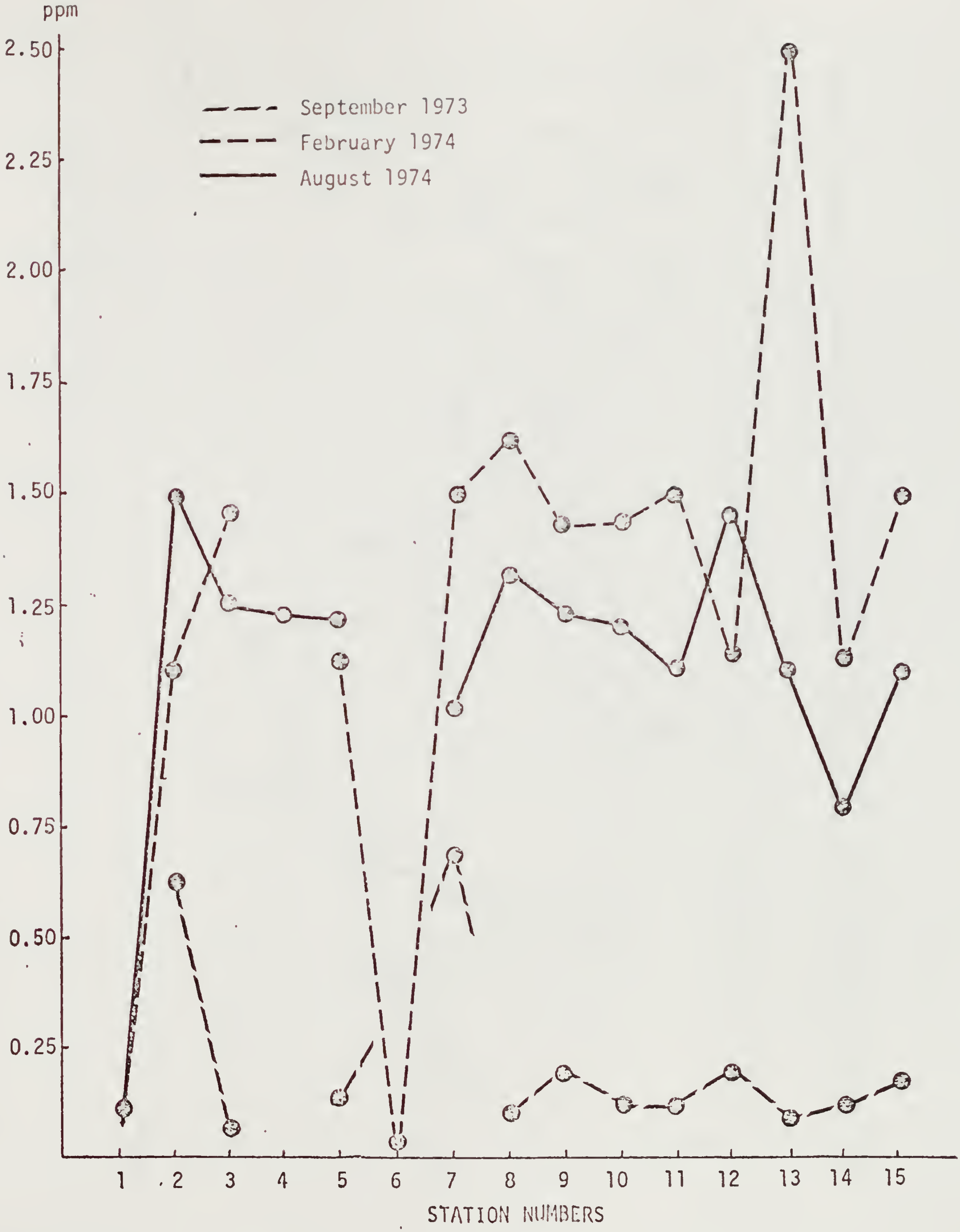

Figure 12. Copper concentrations at all stations by sampling periods.

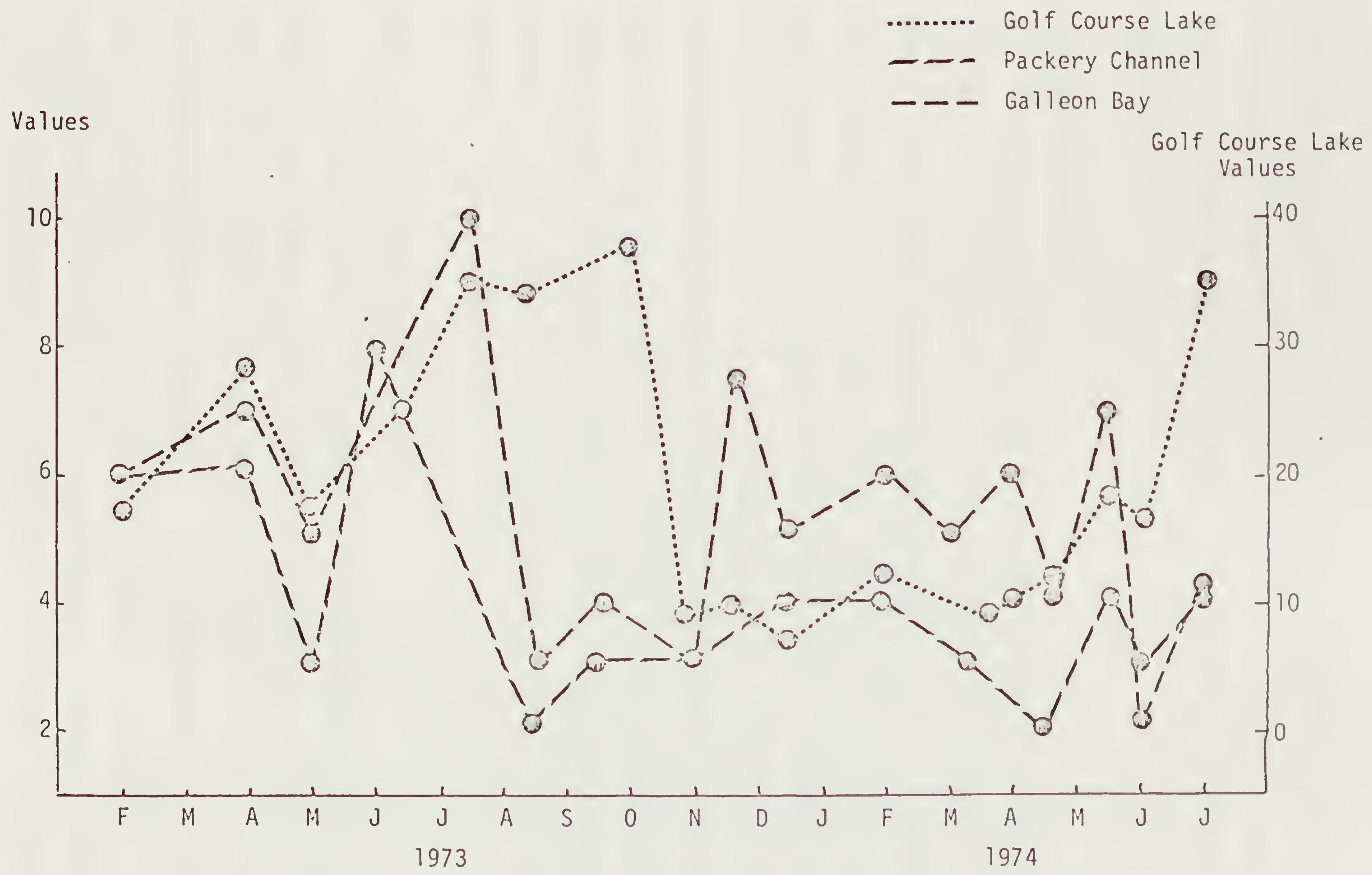

Figure 13. Biological oxygen demand (BOD) levels at all stations by months for three localities. Data from Padre Island Country Club, analyzed by Williams & Miller, Inc.

completely acceptable for normal water quality standards. Although the Golf Club Lake values are higher, they are all still acceptable by most water quality standards--indicating that the sewage treatment plant is efficient in extracting organic matter.

Rainfall and weather

A final set of graphs deals with monthly rainfall records collected at the Padre Island Country Club by Mr. David Gregg. Figure 14 depicts rainfall in inches for each month from January 1973 through July 1974. Note that very high values characterized the latter part of 1973, while low rainfall occurred in the winter and early spring months of both 1973 and 1974. Although not shown here, little rain fell between June and late August 1974, producing hypersaline conditions late in the summer. In terms of total rainfall up to August, drought conditions prevailed during the 1974 sampling year. Wet months preceding the sampling periods in 1973 and February 1974 produced low salinities through excessive runoff. Weather data for the area of the Padre Island National Seashore are given in Table 12.

General water quality summary

In general, water quality at all stations except the Golf Club Lake, the transient pond between the beach and Padre Island Drive (Station 6), and at the station located east of the utility area (Station 13) were within normal ranges of chemical and biological variables at all sampling periods. Nine of the 10 variables measured in the Golf Club Lake had either the highest or lowest values; not surprising, as the lake is the only permanent freshwater body consistently monitored. Station 13 was characterized by three highest measurements and one lowest; suggesting stagnation as the dredged area has little circulation at its terminal end. Other stations characterized by at least two disturbance

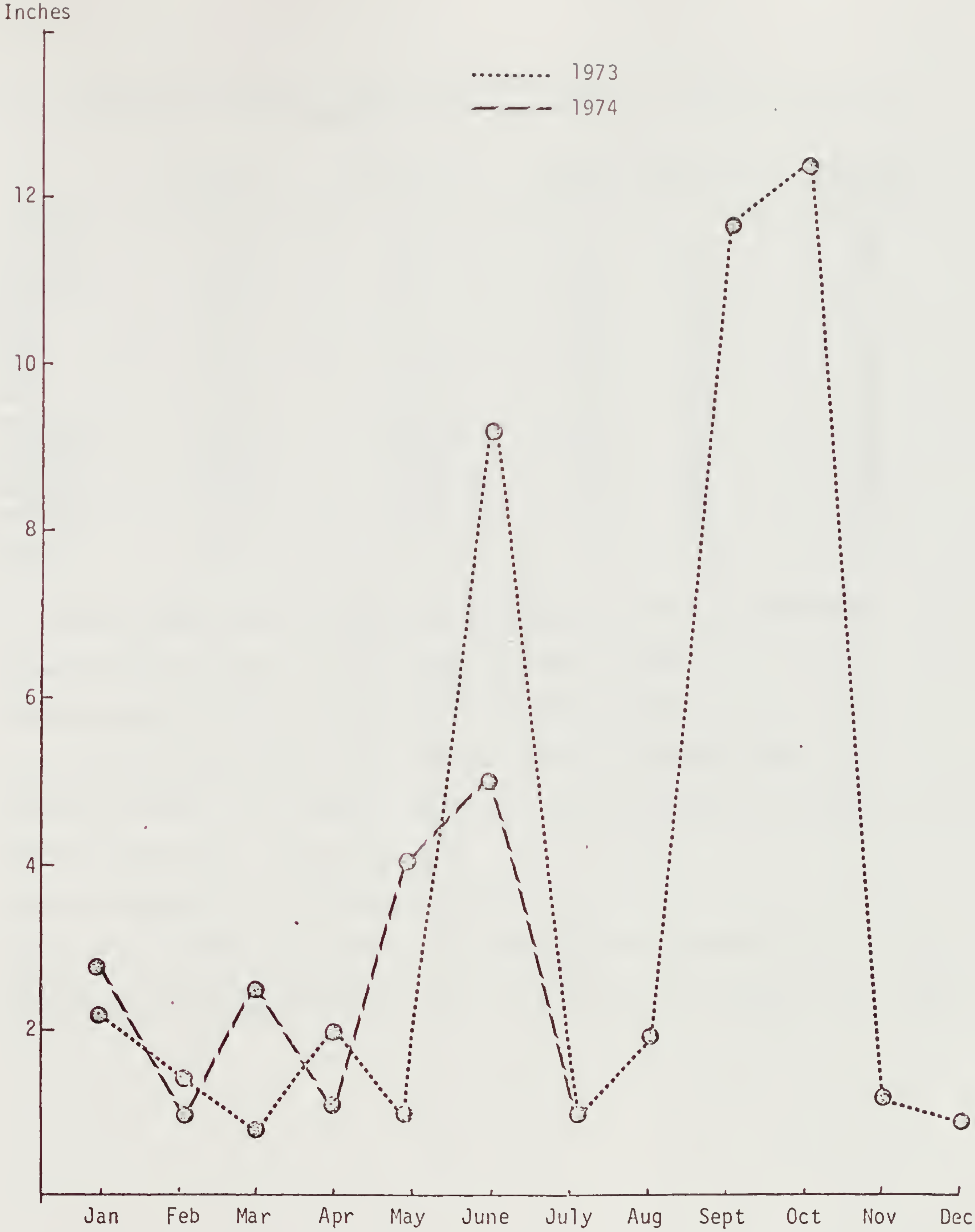

Figure 14. Rainfall at Padre Isles by months from January 1973 through July 1974. Data from Padre Island Country Club, taken 5:00 a.m. each day.

TABLE 12. Weather summary--Padre Island National Seashore

AVERAGE WEATHER CONDITIONS

Month	Rainfall (in)	Temperature (°F)	Wind Speed mph	Wind Direction	Relative Humidity
January	1.49	56.4	11.9	SSE	69
February	1.56	59.0	12.9	SSE	69
March	1.41	64.8	13.9	SSE	63
April	1.87	71.4	14.3	SE	67
May	3.10	76.7	13.1	SE	71
June	2.65	80.9	12.0	SE	66
July	1.82	83.1	11.6	SSE	59
August	2.19	83.4	11.0	SSE	60
September	4.51	80.5	10.0	SE	63
October	2.45	73.9	9.8	SE	59
November	1.82	64.9	11.2	SSE	63
December	1.74	58.2	11.1	SSE	65
Annual	26.61	71.1	11.9	SSE	64

SOME EXTREME WEATHER RECORDS FOR THE COASTAL BEND AREA OF SOUTH TEXAS

*Greatest Annual Rainfall: 44.35 inches recorded in 1960

*Smallest Annual Rainfall: 14.66 inches recorded in 1963

*Greatest Monthly Rainfall: 20.33 inches recorded in September 1967

*Greatest Snowfall: 6.0 inches in January 1897 with 5.0 inches falling in one day

*Highest Temperature: 105 in July 1934

Lowest Temperature: 11 in February 1899

Highest Wind: 180 miles per hour during the hurricane in August 1970

Last hurricane to affect Corpus Christi: Hurricane Celia in August 1970. The eye passed over Corpus Christi.

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*Records for the last thirty (30) years

measurements were Stations 5 (inner residence canal), 6 (the transient pond near a sewage leak from a local motel), 7 (near the hotel complex sewage plant), and 8 and 10 (in the Galleon Bay residence canals)(Table 13). No water quality disturbance factors were observed for Stations 2, 11, 12, 14, and 15, all on the perimeter of the development either in Packery Channel or the Laguna Madre. These data, therefore, do suggest that there has been some impact of development on local water quality within its boundaries. However, all water bodies are artificial, thus by nature of their construction they are impacted by human activity. It should be added that all impacts are minimal and do not reflect conditions which for the most part are deleterious to aquatic and human life.

Aquatic Organisms

Five trophic levels were measured at most aquatic stations. That is, five important links in the food chain were investigated: bacteria (the most abundant and the smallest organisms); phytoplankton (the basis for aquatic production); zooplankton (the grazers on the planktonic plants); benthos (a mixture of organisms feeding on organic matter in the bottom, zooplankton, tiny animals, and suspended food particles); and fish (the top of the food pyramid, feeding on zooplankton and benthos). A disturbance of population levels of any of these food chain links influences all links above it, and eventually those below it, in a closed food cycle such as developed in the residence canals with limited tidal influence. In order to determine exact interrelationships between all these food (trophic) levels, quantitative data are needed for each step. These type of collections, along with measurements of body weights of all organisms, are seldom made and were not possible to make with the limited funds available for this project.

TABLE 13. Disturbance factors measured at Padre Isles aquatic sampling stations

Water Quality Parameter	Stations 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
pH	+				-										
Dissolved Oxygen	-							-	-				-		
Nitrogen	+				-			+							
Orthophosphate	+						+						+		
Coliform Bacteria	+			+			+			+					
Chlorinity			+			-				+					
Calcium	-					-							+		
Magnesium	-					-							+		
Copper	-					-									
BOD	+														
Total Extremes	9	0	1	1	2	4	2	2	1	2	0	0	4	0	0

+ = high values

- = low values

Bacterial populations

The lowest trophic level populations, bacteria, have already been mentioned through discussions of coliform counts in the Water Quality section (page 19) of this report. Total bacterial counts were not made, but coliform counts can be considered somewhat indicative of conditions which support large bacterial populations. This is especially true of counts made on sediments or bottom material. This assessment was made only in January 1973 (Bryant, et al., 1973, pp. 126-127). Counts were so high then that it was not possible to make accurate judgments, thus these measurements were not repeated during later trips. Counts of just coliform organisms of 9.2 X 10^4 would suggest enormous total counts as coliforms constitute a very minor part of the total bacterial species complex in marine waters.

Highest bacterial populations, based on C.E.M.'s water and sediment coliform counts (Bryant, et al., 1973), are found at Stations 1, 6 (now dried up), 9, 10, 11, and 13. All of these stations are located within the boundaries of Padre Isles. Lowest counts of coliforms were observed at Stations 2, 5, 8, 12, 14, and 15. Of these six stations, four were outside of the development; suggesting that in terms of bacterial production in January 1973, the waters of Padre Isles are richer than those surrounding it. During other sampling periods these relative abundances held true except at Station 8. Bacterial populations at Station 8 took a dramatic jump in 1974--averaging 1,540 cells/100 ml, while in 1973 counts were averaging only 121 cells/100 ml. The 1974 increase is surprising since Station 8 is located next to the Galleon Bay sewage treatment unit, which had a line leak in January 1973, but was fixed in 1974. The high 1974 coliform counts in this portion of the canal may be evidence of a continued leak.

Plankton organisms

Because plankton organisms are extremely transient and vary greatly in number from hour to hour and place to place, no great emphasis was placed on their abundances. Using a nonquantitative half-meter plankton net with a #25 mesh opening, samples were taken at three locations with some regularity. Stations 8, 12, and 14 were selected as representative of relatively stable conditions in the canals at the periphery of the development, and thus are representative of plankton communities. Unfortunately only phytoplankton were counted in January 1973 and also only at Stations 12 and 14. Nevertheless, some relationships can be established. These counts are tabulated in Table 14. Data were plotted (Fig. 15) for these three stations as to number of phytoplankton and zooplankton for each sampling period. Note that August counts were so high that they are plotted on a million scale, while other months are in thousands. For the most part, low counts of phyto- and zooplankton were obtained from samples collected in 1973 and only slightly higher in February 1974. During this period, salinities and nutrients were low because of high rainfall. Both zooplankton and phytoplankton counts were relatively high in February--characteristic of low growth periods.

During periods of spring plant blooms (not sampled so far), phytoplankton far exceeds zooplankton. Immediately following a bloom, as shown by August 1974 counts, zooplankton far exceed phytoplankton as a result of their grazing upon the plants. Extremely large numbers of zooplankton in August 1974 also reflects a period of reproduction for larger invertebrates who have planktonic larval forms. At least 80 percent of the zooplankton organisms found in August were larvae of larger animals.

It is most likely that the real base of the food pyramid in this locality is not phytoplankton, in that nutrients are apparently rather low and waters

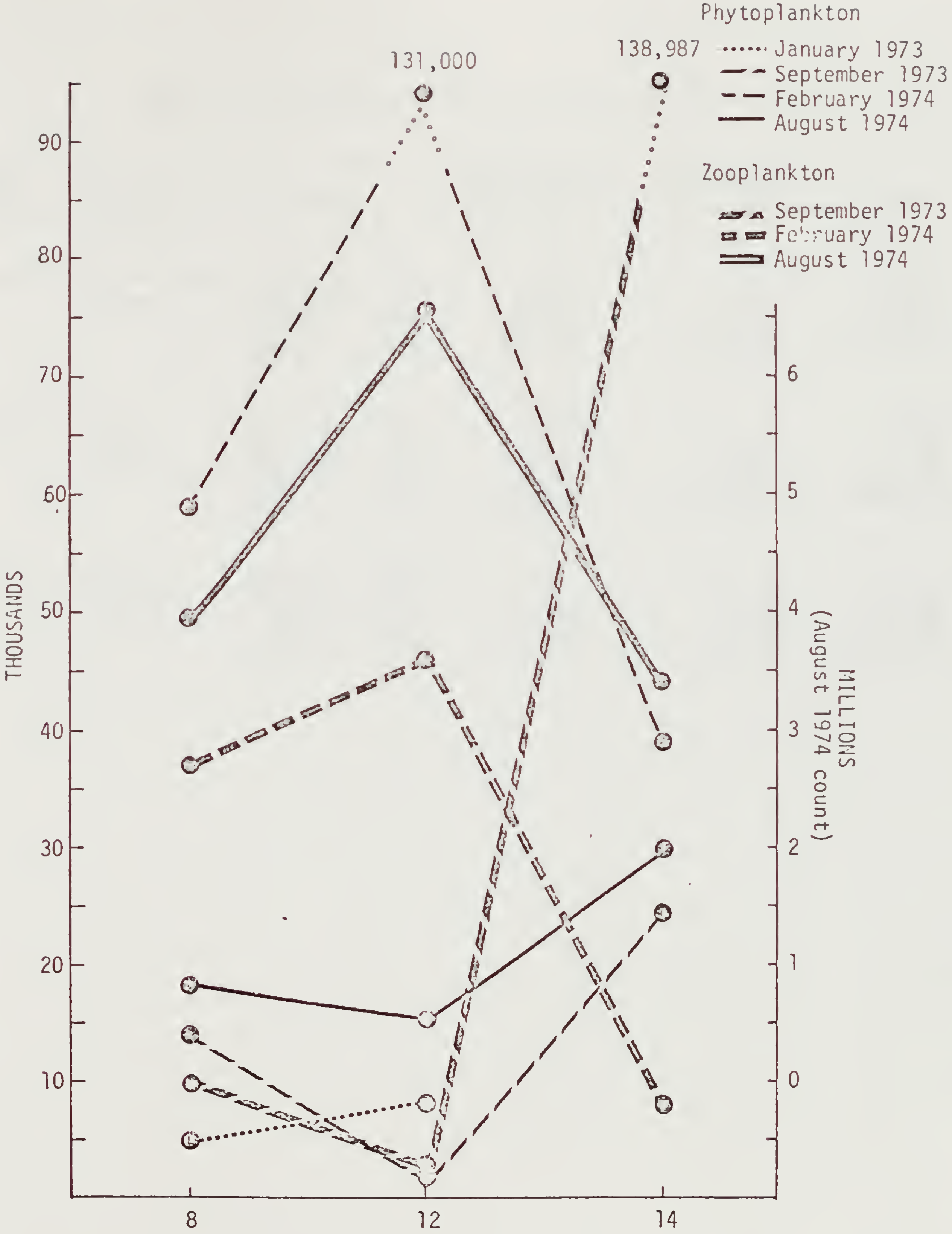

Figure 15. Phytoplankton and zooplankton populations at selected stations. Note--August 1974 count is in millions, the other counts are in thousands.

TABLE 14. Plankton populations at selected stations

Station	Location	Date	Phytoplankton per liter	Zooplankton per liter	Total
PI-8	Galleon Bay Canal	January 1973	4,892	...	4,892
		September 1973	14,081	9,936	24,017
		February 1974	59,000	37,000	96,000
		August 1974	825,000	3,948,000	4,773,000
PI-12	Laguna Madre	January 1973	8,290	...	8,290
		September 1973	1,699	2,517	4,216
		February 1974	130,000	47,000	177,000
		August 1974	533,000	6,510,000	7,043,000
PI-14	Utility Complex Canal	January 1973	...	...	
		September 1973	24,590	138,987	165,577
		February 1974	39,000	8,000	47,000
		August 1974	1,963,000	3,425,000	5,388,000

are seldom clear enough for penetration of radiant energy to produce a large plant crop. As mentioned previously, this area may be characterized by extremely high bacterial populations, similar to those reported by Oppenheimer (1960), and Odom, Cuzon du Rest, Beyers, and Allbaugh (1963) for Redfish Bay and the northern Laguna Madre. Bacteria rather than plankton support the larger organisms found here. It is possible that when construction ceases (lessening turbidity) and more irrigation and fertilization takes place on residence lands, plankton production will increase.

Benthos (small bottom animals)

The next trophic level after zooplankton and phytoplankton in terms of size are the small bottom invertebrates. All of these organisms, however, do not necessarily feed completely on plankton. Many benthos, such as nematodes, polychaetes, some mollusks, and crustaceans, feed only on detritus (decomposed organic matter made palatable by bacterial breakdown) or on the bacteria themselves. They are an important step in the food chain--furnishing the major food source for the majority of important food fishes on the Texas coast. Presence or absence of these animals in large areas are excellent indicators of productivity of the bottom. Rich bottom populations usually sustain large numbers of trout, redfish, and flounder.

Previous studies on the Texas coast have shown that quantitative counts of these smaller animals reveal both the apparent *health* of the area under study as well as disturbance or adverse conditions. High populations and high diversity indicate normal marine conditions, while high populations and low diversity indicate favorable conditions at the lower or upper levels of tolerance of most animals, while low populations and low diversity indicates adverse conditions for most or all marine animals (i.e., fresh water, extreme high salinities or temperatures or extremely low temperatures, lack of oxygen,

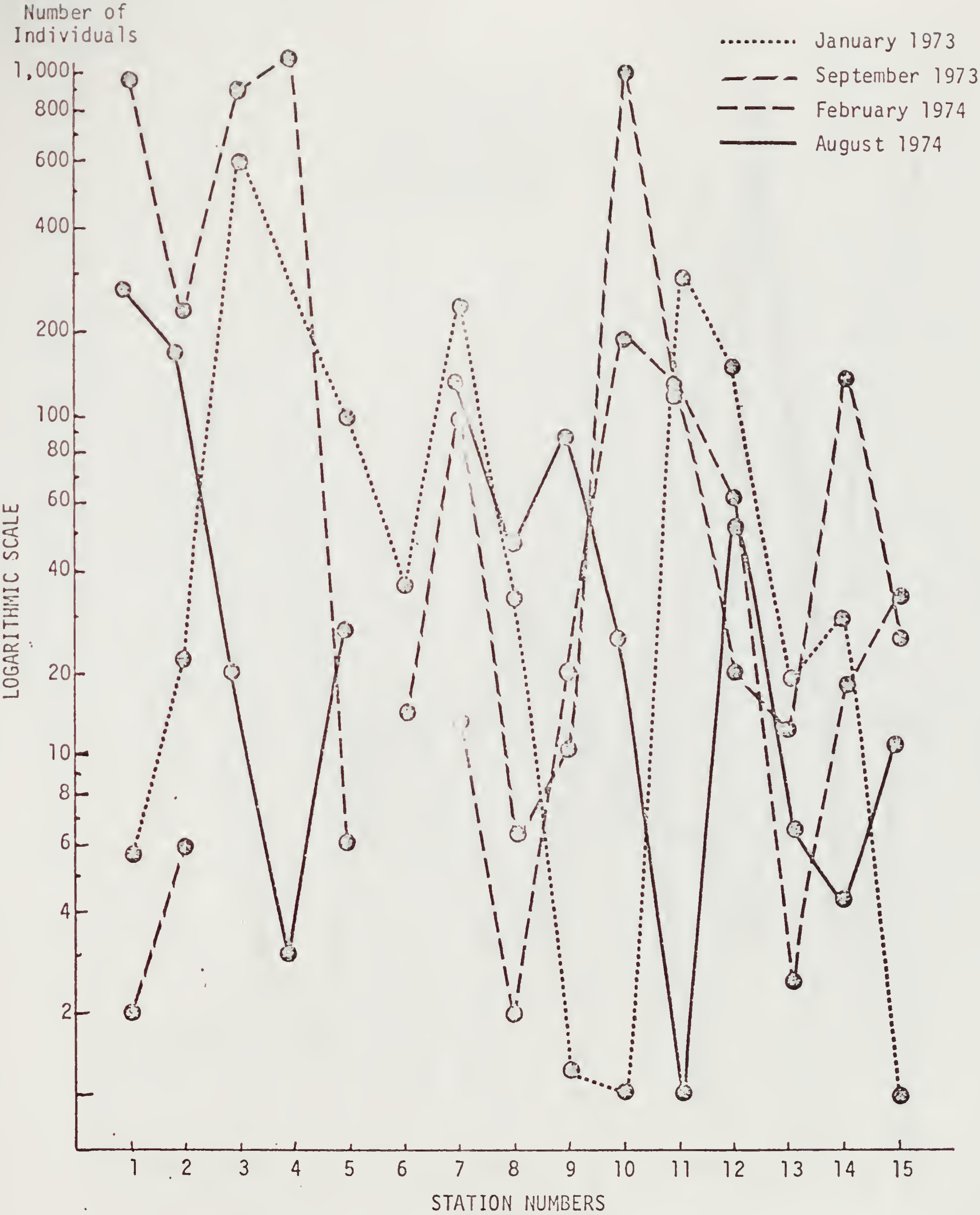

Figure 16. Benthic invertebrate counts per 1/25 m^2 sample at all stations by sampling periods.

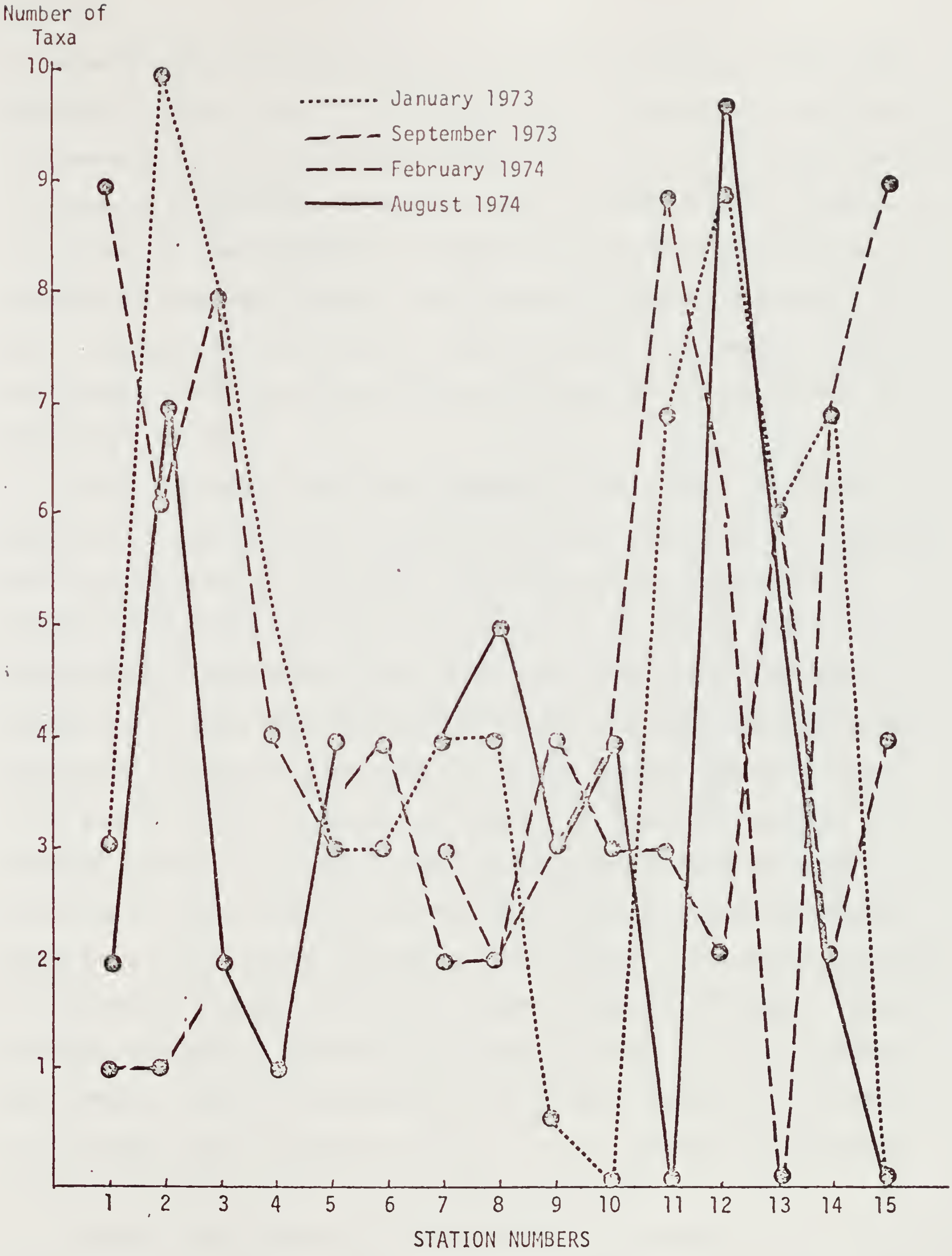

Figure 17. Number of benthic taxa per 1/25 m^2 at all stations by sampling periods.

of season Stations 4 through 10 have very few kinds of animals (1 to 5). Of these seven stations, five are located on canals. The other two are in the shallow extensions of Packery Channel--one of which has since dried up. What is perhaps most significant, however, is that the number of kinds of animals has remained the same throughout all sampling periods, while other stations showed wide fluctuations with only one or no animal types occurring at least once. This suggests that the canals offer stability of environment. Although not so marked as taxa number, populations of animals are also more stable in the canals (Fig. 16).

Diversity indices combine the attributes of both number and kinds of animals and are used by many ecologists as the best indicator of environmental stability, adversity, or excellence. The Shannon-Weaver diversity index calculations have been plotted for all stations at all seasons (Fig. 18). Although these figures combine the observations on both number and kinds of animals into a single value, mathematical calculations reduces wide variations which result from having large numbers of animals and small number of kinds versus a very few animals--each one different. In other words, extremes are modified. Note that on Figure 18, the great fluctuations of values typical of the curves on Figures 16 and 17 are reduced. This criteria for environmental impact demonstrates seasonal differences quite clearly. Both summer sampling periods produced lowest diversities throughout. Regardless of human activity, therefore, combined low populations and kinds of animals occur in the hottest summer months. This is to be expected, as most marine animals are intolerant of high temperatures and hypersalinities. It also is known that the majority of Gulf coast animals breed in the spring or late fall.

Overall lowest diversities were evidenced at Stations 4, 5, 6, 7, 8, 9, 10, and 15. Again residence canals are the predominant sites for low biotic

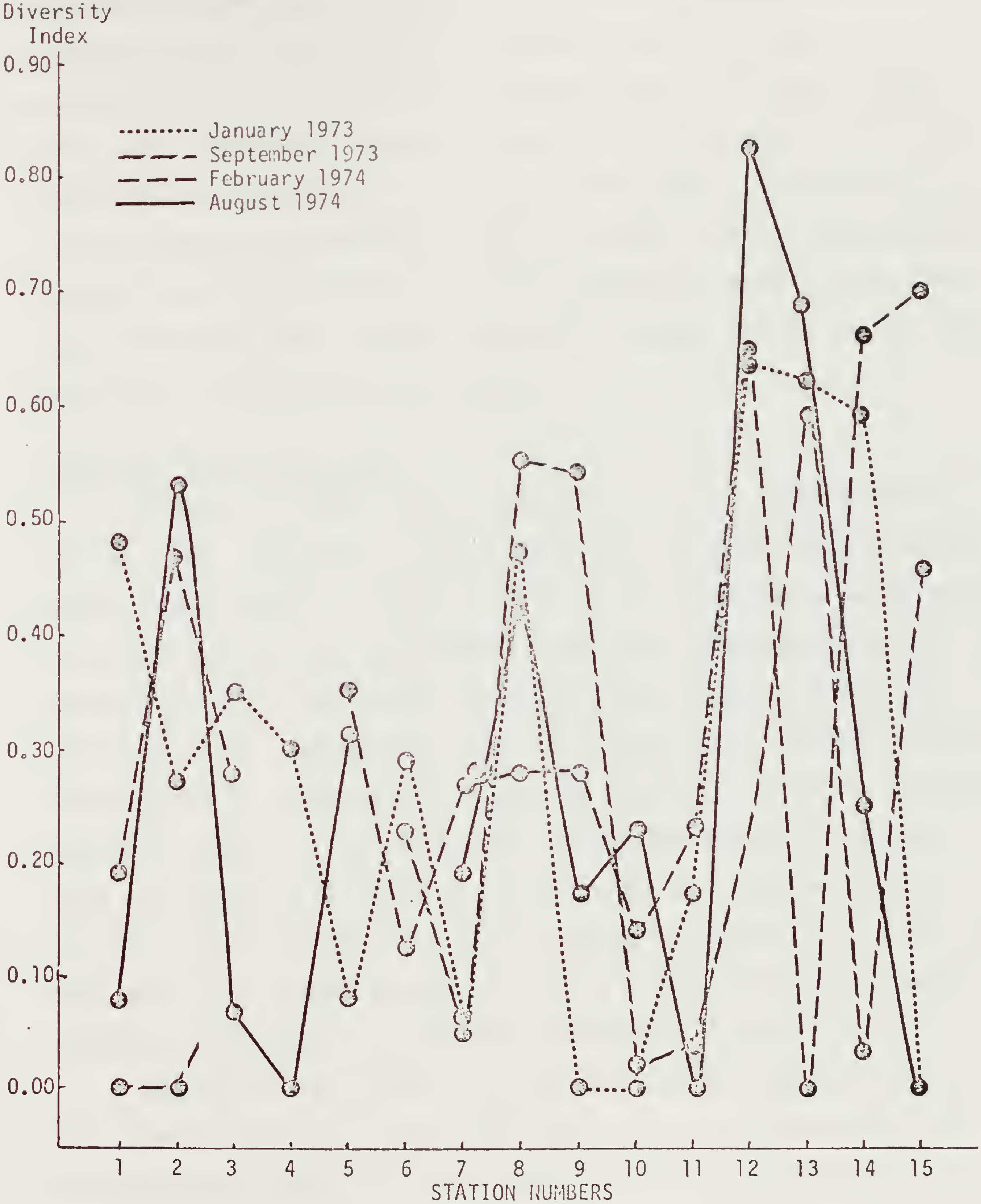

Figure 18. Diversity indices (Shannon-Weaver) for benthos at all stations by sampling periods.

activity, as shown by consistently low faunal counts obtained from stations located in canals. Station 6 is at a transient pond, 7 is located in a partially dredged area, and 15 is at a dredged barge stop for shell barges. These three stations are indicative of and are correlated with some form of human activity. Stations with highest consistent diversity indices were 2, 11, and 12, located at the boundaries of the development. Later, a comparison will be made of populations, number of taxa, and diversity of animals at the Padre Isles stations and those located a considerable distance outside the area that were taken during the Padre Marina study.

Nekton and larger invertebrates

The terminal trophic level or last link in the food chain considered here is fish, large mollusks, crabs, and shrimp--some are strictly predators, feeding on small benthos and large plankton, while others feed on large detritus or scavenge dead and decaying organisms. Some fish, such as mullet and the herring-like fishes, feed directly on phytoplankton. Shrimp and many crabs feed on carrion or dead material almost exclusively. This marvelous diversity of life in the sea, from bacteria to porpoise (a mammal), manages to account for most of the energy which passes from the sun and into the sea's food supply being utilized bit by bit by different sized organisms. Left-over energy is dissipated as heat and waves, or stored for later use as fossil fuels (oil, gas, coal, peat, etc.). Understanding this process of energy flow permits better management, especially in such a complex development as Padre Isles.

Quantitative measurements of nekton and larger invertebrate populations are extremely difficult and almost impossible in the narrow confines of the areas where most sampling took place. For the most part, an 8-foot (2.5 meter) wide otter trawl was towed for 10 minutes in the area being sampled. All

animals were saved, counted, identified, sized, and sexed (if possible). As these samples are extremely diverse, graphic presentation of data is difficult. Table 7 lists these data from the last two surveys, while previous collections are listed in Table 6 (Appendix I). In some cases where a large boat could not be used, a 20-foot seine was used. Although not comparable as to catch effort with an otter trawl, all data are listed together. Data for three seasons and six stations are graphed for total animals only on Figure 19. Breakdown as to numbers of invertebrates and fish for all stations is given in Table 15.

As can be seen on Figure 19 large animal populations are relatively stable compared to benthos, bacteria, or plankton. Except at Station 8 in February 1974 and Station 11 in September 1973, all catches fell between 2 and 26 animals and differed little from season to season. Data plotted on Figure 18 represents three different habitats: natural channels (Stations 2 and 3), dredged channels (Stations 8 and 11), and Laguna Madre (Stations 12 and 14). Lowest figures on the average were in the Laguna Madre, while highest counts were in the undredged portion of Packery Channel. On the other hand, the highest single count--nearly 10 times all others--were found in the Galleon Bay residence canals. The fact that these canals are good habitats for fish is borne out by the fact that during the past year and a half sports fishing was better there than at any other part of the immediate region. In fact, large fish, extremely large blue crabs, and virtually the only shrimp in the region were found in the Galleon Bay canals during the August survey. Both the upper Laguna Madre and Corpus Christi Bay were so bad for commercial fishing during August that all local boats were tied up at the docks.

The bulk of the larger animals taken was made up of fish; although, 261 juvenile shrimp were taken at Station 2 located by the Packery Channel bridge in September 1973. In February 1973, most of the large animals were

TABLE 15. Counts of fish and large invertebrates from trawl and seine catches, 1973-1974

Station	Sampling Device	September 1973			February 1974			August 1974		
		Fish	Invertebrates	Total	Fish	Invertebrates	Total	Fish	Invertebrates	Total
2	Seine	66	261	337	11	5	16	...	...	...
3	Seine	12	3	15	...	...	...	Trawl→ 40	20	80*
7	Seine	...	...	...	...	...	...	11	1	12
8	Trawl	7	1	8	137	0	137	20	5	25
11	Trawl	100	4	104	24	1	25	4	0	4
12	Trawl	1	1	2	6	0	6	8	6	14
13	Trawl	12	9	21	26	0	26	...	...	...
14	Trawl	7	5	12	15	0	15	6	4	10
15	Trawl	...	...	...	...		...	13	13	26
Corpus Christi Bay: 25-foot otter trawl								94	8	102

*For graphic comparison, the total count at this station was divided by 3.

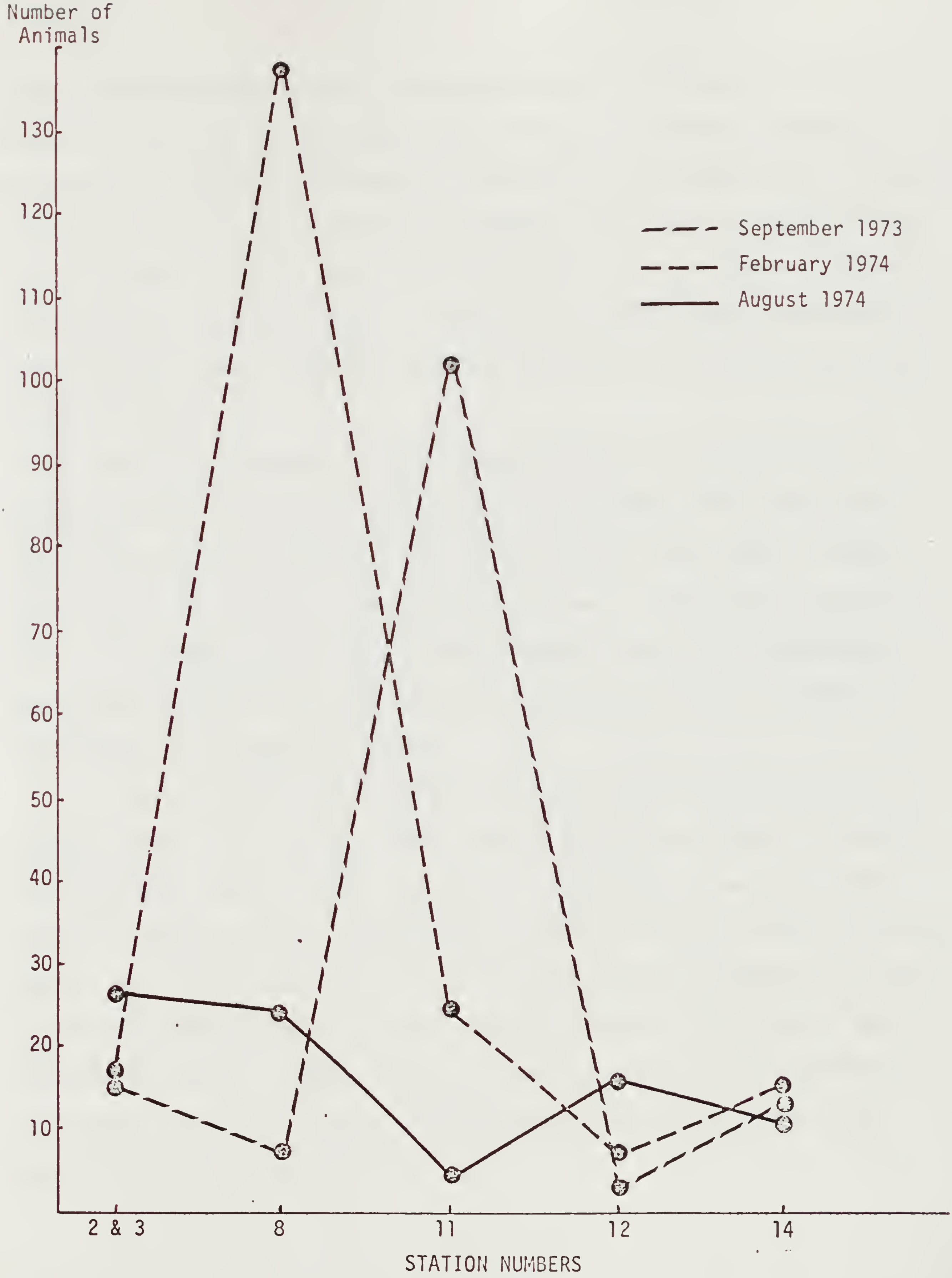

Figure 19. Comparisons of the larger animal's populations at selected trawl stations. Stations 2 and 3 in Packery Channel, Stations 8 and 11 in Galleon Bay Canal, Station 12 in Intracoastal Waterway, and Station 14 in Laguna Macre.

Anchoa mitchilli (Valenciennes), the bay anchovy; while the majority of fish taken in August 1974 were spot [*Leiostomus xanthurus* (Lacépède)], pigfish [*Orthopristis chrysoptera* (Linnaeus)], and whiffs (*Citharichthys* spp.). During the August sampling one invertebrate predominated, but does not appear in the counts in Tables 7 and 15. Over 40 medium to large male and female *Callinectes sapidus* Rathbun, the blue crab, were taken, but were eaten before becoming part of the official count. Largest concentrations of blue crabs were found in the Galleon Bay canals.

Data from this segment of the food chain would indicate that during periods of normal adversity, high temperatures and hypersalinity, many fish, shrimp, and crabs take refuge in the residence canals where waters are deeper (thus cooler) and fresher as a result of ground water and possibly irrigation runoff. The addition of the many planned residence canals (if circulation is maintained) could lead to increased overall abundance of the recreationally desired fish and invertebrate species.

It should be added, that although fish and shellfish comprise the most important trophic level to man, their presence were not measured as frequently and thoroughly as that of other organisms. Difficulties in capturing these animals in shallow areas and within narrow canals contributed to this deficiency. However, the fact that all are very motile and move from one habitat or area to another with great frequency, reduces the value of their distributional data in quantitative surveys. Month to month variations in the commercial segments of this trophic level can be gleaned from fishery statistics published by the Texas Parks and Wildlife Department.

Sediments

Sediment samples were collected and analyzed for the Feburary 1974 stations. In August 1974, sediments were only collected at Stations 8 through 15. By comparing analyses of sediment size fractions for 1973 with data for 1974 (Tables 3 and 4, Appendix I) it can be seen that some changes have occurred. For instance, eight of the samples taken in 1973 had sufficient amounts of silt and clay to be termed silty or clayey sands. On the other hand, only one 1974 sample (at Station 12 in the Intracoastal Waterway) had sufficient clay to designate it as a clayey sand. Only four samples taken in February 1974 had less than 90 percent sand, and all had more than 80 percent sand. Higher amounts of clay and less silt, however, was typical of 10 of the 15 samples which suggests that a significant change at a minor level had taken place.

Sand increased for the most part, yet so did clay, both increasing at the expense of silt. Silt is usually brought in from the river flows, while clay sized particles are a normal component of bay bottoms and formed from degradation of organic matter and the long-term suspended material of rivers. Sand could have blown in with the increased winds of the 1973 year, while clay could have been settled out finally from heavy floods of the summer of 1973. Neither the slight increase in sand nor slightly larger increase in clay could be attributed to construction processes taking place at Padre Isles. For the most part, construction was slow during the fall and winter of 1973-74. In fact this period was one of least action in human activity for over a year. It is quite possible that the sediment composition of February 1974 more closely reflects *normal* conditions.

It is significant that the highest benthic animal diversity indices calculated for 1974 stations characterized Station 12, the only area with significant amounts of silt and clay. It is well known that benthic standing

crop and diversity is highest in mixed sediments (Parker, 1974). Pure sands or pure clays are considered adverse habitats for most burrowing forms, because there is little space between sediment grains for accumulation of organic matter. The association of higher diversity with mixtures of sediments is borne out by Padre Isles data.

Terrestrial Organisms

The obvious changes taking place in the Padre Isles area can be observed on land. It is actually more difficult to obtain quantitative figures for terrestrial ecosystem trophic levels than for aquatic systems. One reason for this is the different roles that plants and animals play on land than in the sea. For the most part, bacteria do not furnish a direct food source; although they do convert atmospheric nitrogen to available nutrients and decompose flesh to other nutrients for plants. Real pastures of grass furnish the base of the food pyramid--rather than plankton, the *pastures* of the sea.

Another reason that quantitative data are difficult to obtain on land is that land animals are much more motile, and boundaries are not as restrictive on land as in bays or streams. Thus, it is difficult to get a real assessment of numbers, kinds, and weights of birds, reptiles, and mammals. The invertebrates of terrestrial communities are mostly insects, whose diversity, motility, and numbers defy quantitative evaluation. Finally, plant diversity is far greater on land, where many plant species occupy small areas and with their individual distribution dependent more upon seed dispersal than on individual habitats. In the sea, dispersal and habitats are more the function of the life medium and geomorphology of the sea bottom.

For these reasons, no real attempt was made to quantify terrestrial data other than to obtain weights from plant quadrat studies performed in February

1974. Bird, reptile, and mammal data are qualitative and do not include surveys of every square meter of property. Although trap lines were set and run for two nights at each sampling period, these data are only indicative of relative abundances and are not quantitative. They are, however, representative of typical habitats and developed parts of Padre Isles. An attempt was made to collect at nine widely separate locations (Fig. 1) all species of plants flowering in August 1974. Relative abundances of these plants were determined visually.

Birds

Sampling periods have not coincided with migration times during which the majority of bird species recorded are likely to be sighted. The largest populations of birds were observed in January 1973, and the second greatest diversity was noticed in August 1974. Few birds were noticed in the summer of 1973--probably as a result of heavy rains and floods which reduced the aquatic food organisms which attract coastal birdlife. Higher salinities in August 1974 apparently promoted higher populations of shorebirds through increases in small fish and crustacea.

A list of birds sighted during the February 1974 survey was drawn up as part of the Padre Isles Marina study (Parker, 1974a). This list is reproduced below:

Channel Area

Double-crested cormorants (2)
Laughing gulls (2)
Dowitcher (1)
Least sandpiper (1)
Sanderlings (2)
Greater yellowlegs (1)
Ring-billed gull (1)

Channel's Edge

Snowy egret (1)
Great blue heron (1)
Sanderling (1)

Sand Flats

Long-billed curlews (2)
Least sandpipers (8)
Laughing gulls (2)
Little blue heron (1)

Grass Flats

Willets (2)

Only 12 species were sighted in the vicinity of the marina site. Large numbers of great blue herons were nesting on nearby islands some distance from the Padre Isles area, but not within the development. In general, bird life was relatively scarce during the February 1974 survey. Temperatures were unseasonally warm, but this should not have been responsible for low bird populations.

In August 1974, a limited bird census was carried out in nine different areas (plant stations, Fig. 1) and at the regular 15 aquatic stations. Again only 18 bird species were sighted. A list of these by location is given in Table 16. This list contrasts sharply with the listing of 38 species observed in January 1973 and 65 species in September 1973. The fact that drought conditions characterized the Corpus Christi area for five months prior to and during the August survey could account for low bird populations. It is interesting that the largest number of species of birds was found in the vicinity of Galleon Bay; the shoreline of which has been most disrupted by man. Three species of birds were sighted in August that had not been seen previously: clapper rail, black-necked stilt, and hooded merganser. The only passerine birds observed (not listed were English sparrows) were boat-tailed grackles and meadowlarks, which suggests that the drought had reduced both seed eaters and insect eaters.

TABLE 16. List of birds observed at Padre Isles--August 1974

Location	Common and Scientific Names
Marsh across from Galleon Bay	Great blue heron (*Ardea herodias*)
	*Clapper rail (*Rallus longirostris*)
	*Black-necked stilt (*Himantopus mexicanus*)
	Willet (*Catoptrophorus semipalmatus*)
	Laughing gull (*Larus atricilla*)
	Long-billed curlew (*Numenius americanus*)
Golf course	Black skimmer (*Rynchops nigra*)
	Least sandpiper (*Erolia minutilla*)
	Long-billed curlew (*Numenius americanus*)
	Boat-tailed grackle (*Cassidix mexicanus*)
	Meadowlark (*Sturnella* sp.)
Packery Channel and Intracoastal Waterway	Great blue heron (*Ardea herodias*)
	Brown pelican (*Pelecanus occidentalis*)
	*Hooded merganser (*Lophodytes cucullatus*)
	Common egret (*Casmerodius albus*)
	Louisiana heron (*Hydranassa tricolor*)
Galleon Bay	Least tern (*Sterna albifrons*)
	Snowy egret (*Leucophoyx thula*)
	Great blue heron (*Ardea herodias*)
	Willet (*Catoptrophorus semipalmatus*
	Sanderling (*Crocethia alba*)
	Semipalmated sandpiper (*Ereunetes mauri*)

*New sighting for the project

Mammals

Trap lines with 30 large and small snap traps were run, both in February and August 1974. Each line was run for two days so that there were 60 trap efforts made at each sampling period. The number of animals captured in 1974 fell way below the number captured in January 1973 when about 50 traps were set. As shown in Table 17, only two rodents were caught in February and only three in August 1974. Two species not taken in 1973 but trapped in 1974 were the hispid cotton rat [*Sigmodon hispidus* (Say and Ord)] and the spotted ground squirrel [*Citellus spilosoma* (Bennett)]. Ground squirrels had been sighted but not trapped in 1973. The majority of rodents were trapped in the open low coastal sand areas covering the center of the island.

As suggested in Bryant, et al. (1973) when the low coastal sand habitat is eliminated by dredging residence canals and the original habitats are replaced by soil and turf, many native rodents will disappear. On the other hand, cottontail rabbits, gophers, and jack rabbits will increase, because of an increasing abundance of lawns to feed on. Elimination of native habitat and cover may also cause the disappearance of coyotes needed to keep the rabbit population down. It is already evident that the loss of native range and cover in the area between Galleon Bay and the construction-engineering headquarters has resulted in a decrease of small mammals. During the last three surveys, large numbers of cottontail rabbits and jack rabbits were observed at night feeding at the edge of the lawns by the Gulf Stream Apartments. If some form of population control is not exerted upon these animals, they may constitute a serious problem within a few years. Already gophers have become a serious pest on the golf course (David Gregg, personal communication).

TABLE 17. List of rodents trapped or observed on Padre Isles--1974

Common and Scientific Name	Number	Measurement (mm) Head and Body	Tail	Habitat
TRAPPED				
February				
Sigmodon hispidus (Say and Ord) Hispid cotton rat	1	125	86	Low coastal sands
Baiomys taylori (Thomas) Pygmy mouse	1	55	33	Low grass
August				
Sigmodon hispidus (Say and Ord) Hispid cotton rat	1	90	87	Tamarisk grove
Oryzomys palustris (Harlan) Northern rice rat	1	140	116	Sand dune
Citellus spilosoma (Bennett) Spotted ground squirrel	1	(not saved)		Low coastal sands
OBSERVED				
August				
Geomys personatus (True) South Texas pocket gopher				Golf Club fairways
Lepus californicus (Gray) California jack rabbit				Low coastal sands
Sylvilagus floridanus (Allen) Eastern cottontail				Hotel-condominium area, Galleon Bay

Pest control

Discussions with Padre Isles staff regarding rodent control indicated that some problems with rats and mice had developed within the condominiums and with gophers at the golf course. Exterminators were utilized for rodent control in the hotel-condominium area, while strychnine-impregnated grain sorghum was used along with special fences and burrow diggers for gopher control. Both forms of pest control have been moderately successful and have not created environmental problems for the human residents. Other forms of pest control used on Padre Isles are a caffeine repellent for rattlesnakes, Malathion for day to day mosquito control, Intex for rainy season insect control, and a nematocide application three times a year for nematode control. No problems relating to excess pesticide residues have developed with this type of pest control.

Plant communities

The original extent of the various plant communities were mapped in 1973 and depicted in Bryant, et al. (1973, pp 74-75). Since the two surveys made in 1973, some changes in distribution of the original plant communities have taken place. For instance, many canals have been dredged in portions of the low coastal sands community northwest of Padre Island Drive and spoil banks have been built up over the interfingered land areas. Even salt flats vegetation has disappeared as these areas have become dredged to provide water access to residence canals.

A few plant communities in danger of destruction must be preserved. One of these is the shore grass flats at portions of the shores of the Laguna Madre. The original salt marshes once located at the junction of Padre Island Drive and the Utility Complex Road have been elimated by the construction of canals and high spoil areas for housing. A second plant community that needs

preservation is the live oak grove at the southeastern entrance to Galleon Bay. This area is slated to become commercially zoned (shopping center). It is hoped that the ancient and attractive oak trees and red bay bushes be saved and blended into the landscaping of the commercial site, or that they be transplanted to another location. A third special community is the sea oats dune community (coastal dunes) located in a few small patches near the two beach side condominiums along side of the Utility Complex Road and around the edges of the golf course. These areas are so small in size that they can be incorporated into overall landscaping without destruction.

Few plants were collected in February 1974 as only one or two species were in bloom, and identification of plants is almost impossible without flowers or seeds. However, at least 50 specimens of flowering plants were collected in August 1974. Most of these were identified at C.E.M., using C.E.M.'s herbarium. New species were identified and all material checked for accuracy at the Southern Methodist University herbarium by Dr. William F. Mahler. A list of 26 species of plants identified from the 1973 collections was included in Bryant, et al. (1973, pp 70-71). The 1974 list (Table 10) includes 45 identified species, some of which according to Dr. Mahler constitute large extensions of ranges from the east--Florida coast to the south Texas coast. One of these rare species, the red bay, makes up a major part of the live oak copse, which is recommended to be a wildlife preserve. Note that the list in Table 10 is divided into species found at the nine terrestrial stations. These locations can be found on Figure 1. Remarks as to plant cover at the beginning of the study can be found in Appendix I following Table 10.

It is interesting to compare the composition of plants between disturbed and undisturbed portions of Padre Isles. The majority of collections were made in areas where construction had not yet made its impact. However, four areas

have been slightly or moderately disturbed by man. These are: Station D, on the golf course; Station E, reclaimed spoil for utility complex construction; Station F, near a canal area at edge of spoil reclamation area; and Station H, the low flat showing overgrazing and cutting for hay. A comparison of species counts between disturbed and undisturbed plant communities follows:

Undisturbed Stations		Disturbed Stations	
Station	Species Count	Station	Species Count
A	3	D	13
B_1	3	E_1	6
B_2	2	F	8
C	8	H	9
E_2	7		
G	4		
Average	5 species		9 species

The average number of species in undisturbed areas is only five, while nine species is the average for disturbed communities. Note that the reclaimed spoil area has six species, one more than the average for undisturbed areas. Only the broad flat covered by the low coastal sand community has a diversity approaching that of the man-influenced areas.

Although not part of the Padre Isles monitoring study, several collections of plant material were made from localities within and just outside the boundaries of Padre Isles during the February survey. Half-meter frames were placed over typical examples of various plant communities located within and near the proposed marina. All vegetation inside the half-meter frames was clipped off at ground level, dried, and weighed. This was done at Padre Marina Stations 23, 24, 28, 39, and 39^1 shown on Figure 20. Three stations (23, 24, and 28) were located on the island adjacent to Padre Isles property and across from the shell barge bulkhead. The other two stations (39 and 39^1) were

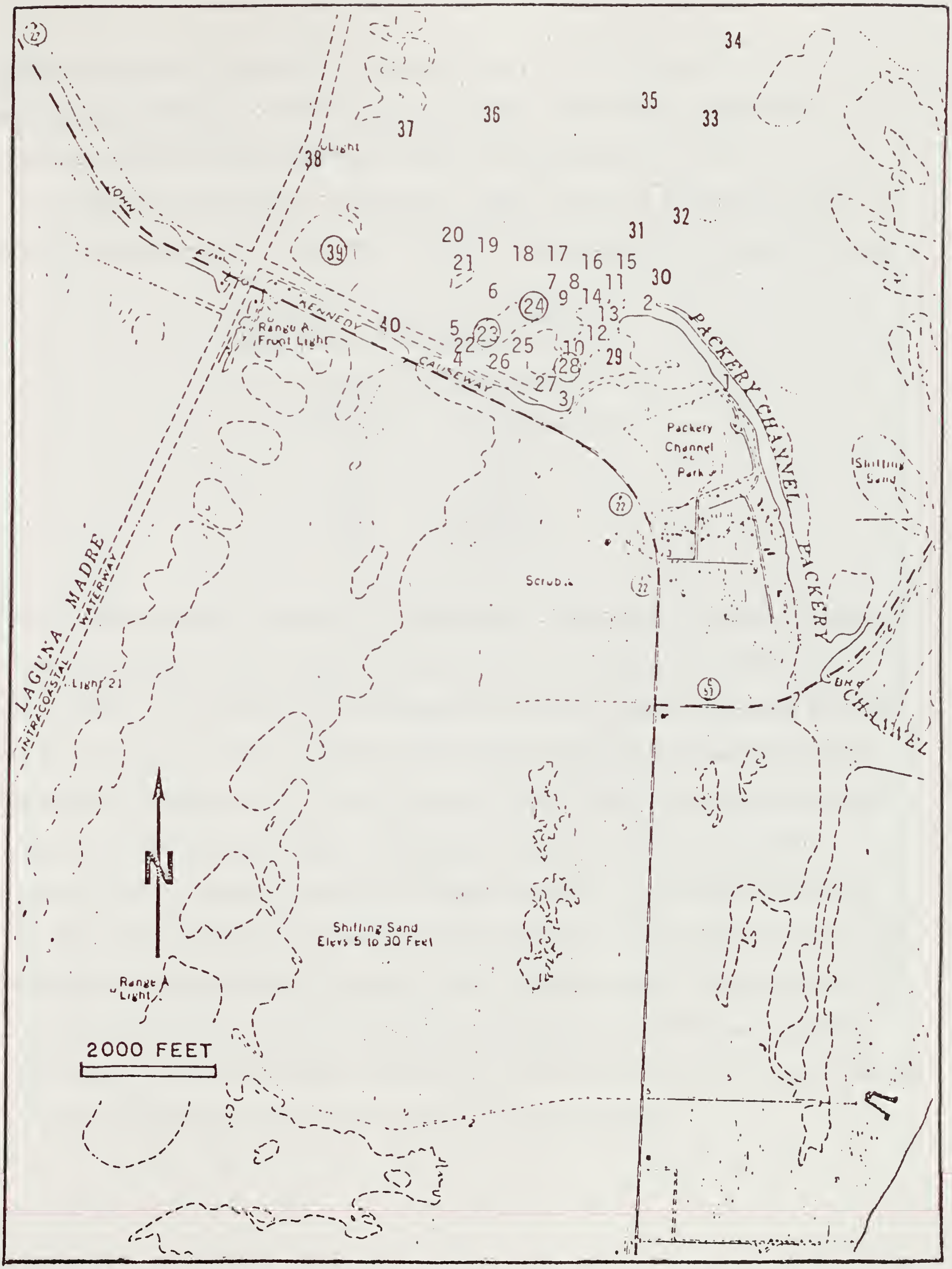

Figure 20. All stations locations for Padre Marina study. Circled stations are plant quadrat stations.

located on a spoil island at the intersection of Packery Channel and the Intracoastal Waterway. All areas are old spoil banks covered by sparse vegetation that has colonized these locations since World War II.

Weights of vegetation clipped from these quadrats are given on Table 18. Note that the weights obtained on the spoil island adjacent to Padre Isles were quite uniform--ranging from 51.4 to 68.7 grams. Weights on the spoil bank where numerous great blue herons were nesting are two to three times higher (127.7 to 222.6 grams). Colonization on these unfertilized spoil banks has been slow and the cover is sparse. Some 10 years has elapsed between the formation of the Intracoastal Waterway spoil island and the Packery Channel spoil island, which accounts for the greater biomass of vegetation on the older Intracoastal Waterway island. Although weights of vegetation were not obtained from areas made up of reclaimed spoil in the Galleon Bay area, it was evident that 10 times the vegetation covered the Galleon Bay soils which are only a few years old. It is obvious that the practise of working in vegetation cut off from the native local range (low coastal sands community) into the spoil, once it has been leached by rains, contributes to the much higher plant productivity.

TABLE 18. Plant quadrat weights--
Padre Marina, February 1974

Station Number	Weight (grams)
23	51.4
24	68.7
28	60.3
39	127.7
39[1]	222.6

Soils and ground water quality

The original C.E.M. survey of Padre Isles included a survey of the soils of Padre Isles as established by the Soil Conservation Service in 1965. An aerial photo with the various soil types marked on it was included in Bryant, et al. (1973, pp 42-43). Most of the region was made up of coastal dune and mustang fine sand soils. Stabilized soils were composed of Galveston and Mustang fine sands. Large areas of tidal flats filled the rest of the region. By August 1974 many of these soil types have been altered or eliminated by depositing spoil on top of them for creation of high land for development.

Additional soil information was obtained from the offices of Messrs. David Gregg and Craig Smalley of the Padre Island Country Club. Apparently in 1971 most of the reclaimed soils created from spoil consisted of grey brown fine sand. These soils have been used to create turf for the golf course; thus, they have received considerable study. According to various experts, Padre Isles soils are deficient in phosphate, potash, calcium, and magnesium. The soil pH's, averaging 7.10 to as high as 8.20, were considered high, very alkaline, and similar to the local sea water pH's. By 1972, pH's had dropped to 5.50 to 7.10 with average pH around 6.70, which is within the acid range. Additional soil samples were sent to the Soil Testing Laboratory at Texas A&M University in 1973. The pH of the majority of samples sent had fallen to around 6.10. Phosphate, potash, calcium, and magnesium levels had been brought up to normal values. Copies of the reports on soils from various sources (mostly relating to the golf course) are included in Appendix II.

Some data as to water quality for ground waters are available. Because the shallow water table receives most of the runoff from irrigation which also leaches the spoil used for soil in Padre Isles, waters are somewhat saline. Ground water is not used for drinking, but is used strictly for irrigation and

mostly for watering the golf course. In April 1972, a test for water quality was made on water from the irrigation pump. Total hardness was 840 ppm, sodium was 72.5% and the pH was 8.6. Other constituents were given. A copy of the report is attached as Appendix III. In November 1972 additional water samples were analyzed by Central Power and Light Company. One sample at a depth of 12 feet was taken at the irrigation pump site, and another at a depth of 15 feet, from the well point system. Total hardness was 816 ppm and 840 ppm, respectively. Sodium percentages ranged from 66.9 ^{o}/oo to 67.2 ^{o}/oo, while the pH was 7.7. Some improvement over the intervening seven months was evident. Data for these analyses are given also in Appendix III. It is evident from these data that ground water is normally very hard and not particularly well suited for many introduced or exotic plants. It is certainly sufficiently fresh for the local native vegetation, which is well-adapted to high salt contents (2982 ppm, 3051 ppm, and 3567 ppm).

COMPARISONS OF DATA FROM THE PADRE MARINA STUDY WITH PRESENT DATA FROM PADRE ISLES

An excellent opportunity was presented for comparing baseline (relatively undisturbed) conditions from similar habitats outside the boundaries of Padre Isles with present conditions within Padre Isles when a special study of the area to be utilized for a large marina was investigated in February 1974. Some 40 stations were occupied within and around the marina site as shown on Figure 20. Stations 1, 2, 3, and 4 are within the confines of the C.E.M. monitoring study, while Stations 5 through 29 are close enough to Padre Isles to be included as representative of relatively disturbed conditions. Stations 30 through 40 are some distance away from Padre Isles and are located in natural grass flats, sandy areas, channels, and dredged canals, so that they constitute

the undisturbed equivalents of Padre Isles aquatic habitats. Extensive analyses of water quality, sediments, and animal life were carried out, which were reported to the U.S. Fish and Wildlife Service, Department of Sports Fisheries; the National Marine Fisheries Service at Galveston; and to the management of Padre Island Investment Corporation (Parker, 1974a). These data can be directly compared with the February monitoring data in order to determine whether or not Padre Isles conditions differ significantly from those elsewhere in the region. Previous environmental comparisons were made either between various Padre Isles habitats or between similar habitats in Padre Isles and other bays or regions.

Water Quality

It has always been assumed that water quality within the residence canals and in the natural channels inside Padre Isles would differ from water quality in the Laguna Madre or Corpus Christi Bay. These differences should stem from the fact that Padre Isles canals are deeper than the Laguna or bay margin waters and receive both ground and irrigation water from surrounding developments which would influence the canals' water composition. In order to determine the extent of these differences, stations were grouped by habitat for those within the development and those outside or relatively undisturbed areas. Three habitats were singled out for comparison; channels, grass flats, and sand flats--the three marine habitats characteristic of Padre Isles and the surrounding bay area. Two more habitats, oyster reefs and deep open bays, do not exist within the boundaries of Padre Isles. Table 19 contains the listing of values for the water quality variables of dissolved oxygen (DO), hydrogen-ion concentration (pH), turbidity (JTU), chlorinity (Cl^-), nitrites and nitrates (NO_2^- plus NO_3^-), and orthophosphate (PO_4^{-3}) for each habitat within each of the two studies. Values for all stations were averaged and plotted as Padre Isles

TABLE 19. Water quality comparison--Padre Isles with Padre Marina

Location	Measurement	DO	pH	JTU	Cl^-	NO_2^- NO_3^-	PO_4^{-3}
			CHANNELS				
Padre Isles (inside development)	Highest	6.8	7.9	25	12.2	2.75	5.00
	Lowest	0.5	7.9	15	10.2	0.49	0.08
	Average	4.1	7.9	18	11.4	1.12	1.35
Padre Marina (outside development)	Highest	7.5	8.2	25	11.0	0.75	0.18
	Lowest	4.7	8.1	15	7.2	0.41	0.05
	Average	6.0	8.12	20	10.1	0.54	0.11
			GRASS FLATS				
Padre Isles (inside development)	Highest	6.5	7.9	15	12.8	0.60	0.13
	Lowest	5.2	7.9	10	11.5	0.37	0.04
	Average	5.6	7.9	13	12.0	0.50	0.09
Padre Marina (outside development)	Highest	7.6	8.2	20	11.3	0.69	0.16
	Lowest	6.1	8.1	13	10.6	0.42	0.05
	Average	6.7	8.11	17	10.9	0.55	0.11
			SAND FLATS				
Padre Isles (inside development)	Highest	6.4	7.9	20	12.5	0.73	0.13
	Lowest	5.2	7.9	10	11.2	0.25	0.03
	Average	5.9	7.9	14	11.8	0.58	0.08
Padre Marina (outside development)	Highest	8.1	8.1	25	10.3	0.75	0.17
	Lowest	7.4	8.1	15	7.2	0.51	0.12
	Average	7.9	8.10	20	8.8	0.61	0.15

averages against Padre Marina averages by habitats (Fig. 21).

It is evident from Figure 21 that within the channels, major differences exist between Padre Isles channels and the control channel stations some distance from human activity. Note that nitrogen and phosphate (nutrients) are very low at the control stations, while Padre channel stations have very high values. High nutrient values in the Padre Isles canals must result from runoff and ground-water seepage from lawns and the golf course where heavy applications of fertilizers had been recommended previously by soils consultants (Appendix II). Within the grass flat and sand flat habitats major differences existed between the development and control stations for turbidity in Jackson Turbidity Units (JTU). Note that in both grass flats and sand flats, the JTU's were 4 to 7 units higher at the control stations than within Padre Isles. Turbidities were higher outside of the development because stations were in unprotected areas where the slightest breeze would stir up bottom muds. Similar habitats within Padre Isles are sheltered from winds by the artificially raised land areas. In general, dissolved oxygen (DO) was slightly higher at the control stations, primarily because waters were shallower and in constant motion. Padre Isles waters were also slightly more saline, because of more stagnation and consequent evaporation.

Aquatic Organisms

More dramatic differences between organism abundances and kinds should exist between control stations and Padre Isles sampling areas. A table of comparative average bacterial, benthic animals, and nekton numbers and diversity indices was drawn up for the same set of habitat station groups that were utilized for water quality comparisons (Table 19). These data were graphed in order to dramatize these differences (Fig. 22). Inspection of Table 20 shows

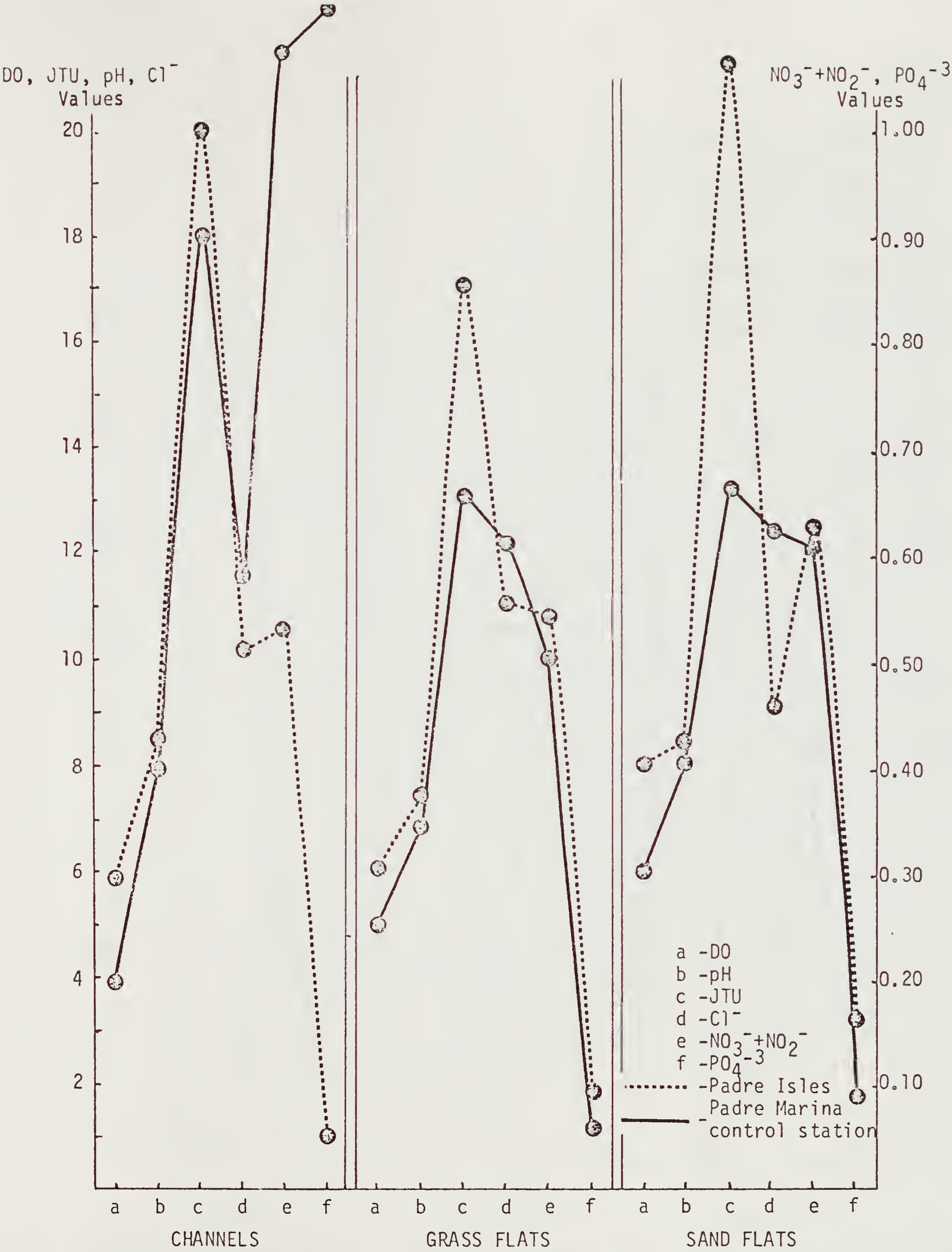

Figure 21. Padre Isles water quality values graphed against Padre Marina water quality values for three habitats.

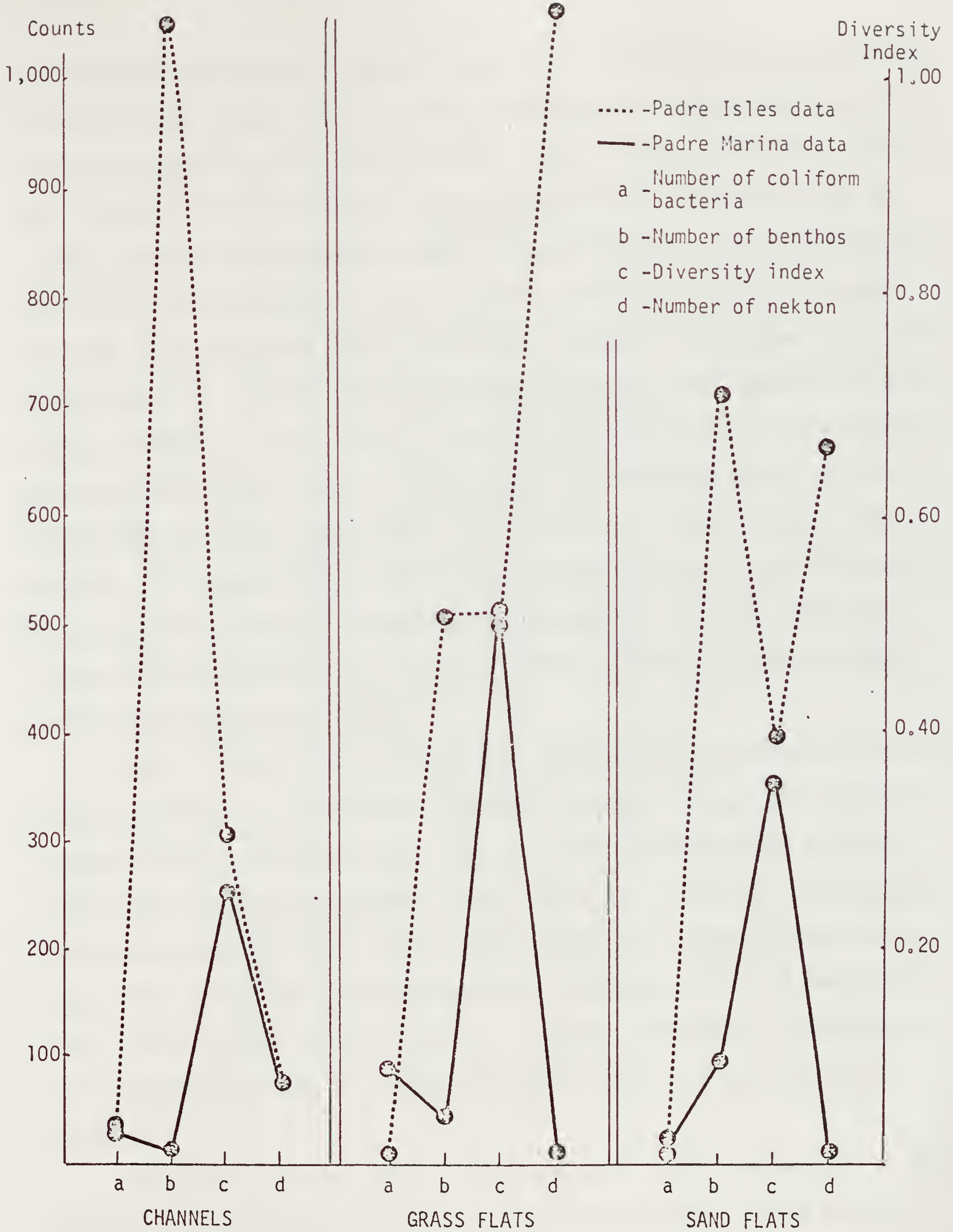

Figure 22. Biological data comparisons between Padre Isles and control stations outside of development.

that relatively few data on organism density and diversity were available from Padre Isles and compared with the Padre Marina study. Emphasis was placed on biological studies for the marina project, thus more data are available. The most striking difference between life in the channels of Padre Isles and the control stations was the average number of benthic animals. Over 1,000 animals per 1/25 m^2 characterized the control stations, while only 10 to 20 animals per 1/25 m^2 characterized Padre Isles canals. Bacterial and nekton counts were almost identical. On the other hand, within the grass flats habitat it was the number of nekton or larger shellfish and fish which was greater in the control area than within Padre Isles. Twice as many larger animals occurred in the undisturbed areas than within Padre Isles (Fig. 22). Within the sand flats habitat, differences between control and Padre Isles stations were centered in both the number of benthic or smaller bottom animals and nekton--the control areas being much richer in overall animal life. In all cases, both coliform counts and diversity were similar.

These differences in animal numbers between similar habitats of the Padre Isles and control areas could be attributed to several causes. For instance, sediments within the control areas were more often than not mixed sediments with higher silt and clay contents than at Padre Isles stations. As mentioned previously, mixed sediments support higher numbers of benthos, which in turn support more and larger fish and shellfish. Sediments within the boundaries of Padre Isles are almost all pure sand (as a result of dredging and winnowing out of fine material so that the bottom character is not the most conducive to bottom life.

Disturbance factors, such as the presence of boats, dredges, storm sewer outfalls, and construction activities in and near the canals could be much

TABLE 20. Faunal comparisons--Padre Isles with Padre Marina

Location	Measurement	Coliform Bacteria	Benthos Number	Diversity Index	Nekton
		CHANNELS			
Padre Isles	Highest	40	21	0.35	137
	Lowest	0	2	0.00	26
	Average	22	8	0.25	81
Padre Marina	Highest	90	4,642	0.63	132
	Lowest	0	82	0.13	21
	Average	32	1,649	0.31	79
		GRASS FLATS			
Padre Isles	Highest	270	55	0.70	6
	Lowest	0	14	0.27	...
	Average	94	34	0.50	6
Padre Marina	Highest	17	1,073	0.79	2,472
	Lowest	0	89	0.17	501
	Average	6	502	0.51	1,486
		SAND FLATS			
Padre Isles	Highest	40	217	0.66	15
	Lowest	1	21	0.14	...
	Average	16	90	0.36	15
Padre Marina	Highest	6	1,952	0.61	658
	Lowest	0	17	0.14	...
	Average	3	721	0.39	658

greater within Padre Isles than near the station areas selected for control or baseline observations. This type of activity could serve to scare fish and other large animals away, but by and large have little effect on the small benthic animals. It is possible that oil and other chemicals from increased human activity could cause a reduction of or discourage settlement of small bottom animals. We do know that oxygen levels within the canals during the previous summer were below tolerance levels for many animals and it is possible that by February 1974 populations had not yet regained normal levels.

Terrestrial Organisms

Control or baseline data for the Padre Isles region as related to terrestrial life are not nearly as reliable as those for the aquatic environment. Comparative data for birds were not collected at the same time, while weights of vegetation were only taken at the Padre Marina and not at Padre Isles. Mammals were trapped only in Padre Isles and not on Padre Marina lands. Plant collections were made for weights, but not for species identification during the February 1974 trip. As no quantitative terrestrial data are available for comparison, only visual and subjective appraisals can be used.

Several reconnaissance trips were made into the area between Padre Isles and the Padre Island National Seashore and north onto Mustang Island. A detailed investigation also was made of the island adjacent to Padre Marina and adjacent to the County Park on Packery Channel. Plant cover on the small spoil islands (equivalent to the spoil lands created for residence lands on Padre Isles) was very sparse. Aside from some *Spartina* and other salt grasses, only three or four other forbs were discovered. One was a very low composite, the other a pea plant (not in bloom) and a low shrub shown in photographs of the islands in Parker (1974b). It was clearly evident that unfertilized dredge

spoil was very unproductive. On the other hand, recently created spoil lands on Padre Isles which had been specially treated with hay harvested from natural or native range were already covered with four to 10 different species of flowers and grasses. These spoil lands were made only two to three years ago while the untreated spoil islands are decades old and still have less ground cover.

The only other oak copses similar to that located at the corner of Galleon Bay (mentioned earlier) is across Padre Island Drive in the same area, and a small one on the edge of the Laguna Madre at the Padre Island National Seashore. This plant community is rare on the barrier islands as our reconnaissance of both Mustang and Padre Islands revealed. Once again, the necessity for preserving this small example of the oak copse within the boundaries of Padre Isles should be emphasized.

Examination of low coastal sands communities in other parts of Padre Island showed no difference between plant composition within Padre Isles and outside its boundaries. This community is richer in places where it has been preserved such as around the golf course than in areas outside of the development. Obviously, increased moisture from irrigating the fairways has encouraged a rich and varied native crop. The open island center meadows within Padre Isles are rather sparse compared to equivalent areas to the north and south of the development. The relatively poor appearance of Padre Isles meadows may be attributed to the constant harvest of vegetation for use in fertilizing the new spoil areas. Finally, Padre Isles dunes appear to have less sea oats on them than the relatively undisturbed dunes at the National Seashore. The lack of sea oats could be a result of intensive picking by Padre Isles' guests.

DISCUSSION OF IMPACT OF PRESENT CONSTRUCTION ON NATURAL ATTRIBUTES OF PADRE ISLES

It was agreed at the beginning of this study that C.E.M. would monitor changes in the overall quality of native wildlife and water quality as development proceeded. The study was begun after considerable construction had already taken place (Galleon Bay area and the hotel-condominium area). Since January 1973 considerable new construction, road building, and canal dredging has taken place (see Figs. 1 and 2). What changes have been wrought in terms of overall increase or decrease in water quality, aquatic life, plant life, and terrestrial animal life in this relatively short time span?

Water Quality

In terms of overall water quality, Padre Isles waters have shown some improvement since January 1973. Of 10 parameters used to characterize water quality, three improved, five showed no change, and two (salinity and magnesium concentration) showed a decrease in quality that was related to decreased rainfall in spring and summer of 1974.

Taking each parameter separately in terms of net change in two years, the following assessments have been made. Rainfall, the driving factor for water quality, was high in 1973 and low in 1974 (up to August). High rainfall dilutes the chemical constituents of sea water (chlorides, calcium, magnesium, and trace elements) and low rainfall brings about evaporation, thus concentrating these same elements. Fresh water also controls pH, thus highs occur in summer (low rainfall) and lows in winter with high rainfall. Change in sewage effluents or aquatic plant growth would cause an overall change in pH to occur. This was not evident.

Dissolved oxygen, dependent more on biological activity than on rainfall, showed an overall increase in values, which is an improvement in the health of the waters. Nitrates and nitrites (forms of nutrients or fertilizers) showed little net change over the two years; however, they reflected leaks in the sewage treatment plants by increased values. When leaks were repaired, nitrate-nitrite values fell back to normal. One nutrient (phosphate) is generated more by human activity than by natural processes. In Padre Isles, phosphate concentrations decreased on an overall basis. This was particularly true in the Golf Club Lake, which would have been susceptible to high phosphate levels and consequent eutrophication (overproduction of plants and decrease in oxygen). The fact that phosphates were reduced suggests that the increased construction and development has not materially affected water quality. Other ions (such as calcium and magnesium) and trace elements (copper, iron, and zinc) fluctuated directly with changes in salinity; thus controls are natural, not man-induced.

Two biological aspects of water quality which affect man the most are coliform bacterial concentrations and BOD's (biological oxygen demand). BOD's steadily decreased over the two years throughout the complex which is an excellent indicator of improved water quality. Coliform bacteria showed little net change in an overall basis. Counts were always very low in open saline waters and relatively high in residence canals. Very high values were coincidental with leaks in treatment facilities.

Biological Quality

For the most part, changes in biological attributes within aquatic systems will be a result of changes in water quality or source of food. Five indicators of biological quality were used: size of plankton populations, size of benthic invertebrate populations, number of kinds of animals, diversity of

life, and numbers of large animals (nekton). Inspection of graphs of these parameters as plotted for two years of data show no net change for three, one parameter increased and one decreased, giving an overall impression of no major changes attributable to man's influence even though numerous canals were dredged.

There was little overall change in numbers of planktonic plants and animals. Fluctuations occurred from season to season and within the dynamics of the community. When plants are initially high, planktonic animals are low. As the animals feed and reproduce, they reduce the number of plants at the expense of their own increase. Plankton measurements represent such a short interval of time for organisms that have such short life cycles that the data presented here are not as meaningful as that generated by collections of larger and more fixed animals and plants.

There were no major changes in bottom animal (less than 1/2 inch in size) numbers over the past two years. However, numbers of animals were lower this summer than last summer, but not much lower than in February 1974. On the whole, populations of benthos within Padre Isles is much lower than for equivalent habitats in the Laguna Madre and the undisturbed passes. Colonization of sea bottom by these kinds of animals is slow and most of the canals are relatively new. Epibenthic animals (those that live attached to hard surfaces; such as, barnacles, oysters, and mussels) have increased enormously in the canals as the bulkheads furnish a surface for attachment. These epifaunal animals provide food for drum and other fish. Reports from fishermen indicate that these particular fish are in good supply in the canals. In fact, nekton (larger animals) showed significant increases over the two years suggesting that the increased encrusting life has encouraged higher production of fish and crabs.

Bottom animal diversity has not shown an overall net change in two years. However, it should be pointed out that diversity is very low in the canals and in areas that are visibly influenced by man. Animal diversity is definitely tied to stability and predictability of the environment. Unnatural disturbances of the environmental milieu almost always result in a drop in animal or plant diversity. The use of diversity indices is universal in determining environmental damage or adversity. The fact that benthic diversity has been very low regardless of animal population size within Padre Isles indicates that normal environmental conditions have not yet become fully established. It may take at least five years of normal salinity and temperature regimes in order for bottom populations to attain a full spectrum of species. It should be emphasized that very hypersaline conditions, very high temperatures, very low salinities, and very low temperatures can influence community composition drastically. The south Texas coast is well known for extreme environmental fluctuation, thus it is difficult to place blame on human interference for aquatic animal reductions in this region.

Terrestrial Plant Cover

Overall changes in plant communities over the past two years are more difficult to document. Quantitative methods for assay were not available and only photographs and individual memories can be used to determine net change. Certain areas were examined at each sampling trip (the golf course, dunes near the Gulfstream, the oak copse in Galleon Bay, dunes near the utility complex site, and the open meadows on both sides of Padre Island Drive). Special emphasis was placed on checking for growth and plant diversity on the reclaimed spoil areas built up for dwelling sites.

It was encouraging to see that recolonization of plants on the spoil areas was very rapid. Within six months, at least six species of flowers and two species of grass were thriving. After two years, it was difficult to tell the difference between plant cover on the native range and plant cover on reclaimed spoil. There is no doubt in our minds that the practice of plowing in hay cut from the native range has brought about this rapid colonization. One needs only to examine old spoil banks nearby that have not been treated with hay to see the difference.

Decrease in diversity of plants in the native range (low coastal sands community) over the past two years can probably be attributed to the continual harvesting of these plants for the spoil bank treatment. Many annuals no longer have an opportunity to seed and mature, since cuttings are quite frequent. Certainly more species of plants can be found on the Mustang Island range or on the range between Padre Isles and the National Seashore.

Dune vegetation has shown little net change in the areas west of Padre Island Drive, but has decreased somewhat on the beach. Opening of Padre Isles beaches to full public use has therefore created environmental pressures on shoreline vegetation. A decrease in marsh vegetation in the central portions of the development and along the shores of Laguna Madre is directly attributable to dredging of residence canals and construction of roads. This is, of course, an inevitable result of development. If areas along the Laguna Madre are not bulkheaded, marshes may again develop. However, it is now unlikely that marshes will develop anywhere else in the project except along the shores of the country club lakes. Building up the land surface to tide proof levels precludes the establishment of future marshes.

Finally, some changes have been wrought in diversity and abundance of wildlife. It is only natural that when cover vegetation is harvested, marshes

eliminated and dune vegetation destroyed that the numbers of animals will change. Certain rodents that need high grass cover have decreased in number, while those that prefer short grasses that promote better visibility to see enemies have increased. Kangaroo rats which are characteristic of natural stabilized dunes have decreased in number. Rice rats which prefer the tall marsh grasses also have apparently decreased in number--to be replaced by cotton rats. Rabbits and jack rabbits have increased considerably in response to the increase of turf grasses and succulent exotic vegetation. Once the area has become fully developed these animals may become the predominant mammal type.

Reptilian life has always been relatively scarce in the Padre Isles region; although rattlesnake populations increase and decrease with changes in rodent populations. With the increase in tropical vegetation around the dwellings there has been a noticeable increase in the number of lizards, particularly anoles or southern chameleons. These attractive green and brown lizards feed on house insects and are very beneficial to any development. Toads feeding on insects attracted to lights around the Gulfstream were also evident.

Bird life has shown some changes over the past two years. During the first year of the development, a large flock of sandhill cranes and another flock of white pelicans were much in evidence in the large empty area in the southwest part of Padre Isles. With the construction of roads and canals and the beginning of the utility complex construction these large and attractive birds have disappeared. Shore birds (herons and sandpipers) have decreased somewhat within the boundaries of the development. This is entirely a result of the elimination of the shallow intermittent ponds on both sides of Padre Island Drive. Many of these ponds have been replaced by bulkheaded canals which are unfit for feeding shore birds. Packery Channel has become much reduced

in size, resulting in a decrease of both ducks and shore birds.

On the positive side, there seemed to be a definite increase in song or perching birds. Growth of the Australian pines, lawns, and vegetation around the buildings has encouraged the establishment of warblers, vireos, flycatchers, cardinals, mockingbirds, grackles, and sparrows. These barrier islands in a natural state have few trees or shrubs necessary to attract such birds. Thus full development will eventually encourage a diverse and populous community of song birds.

Overall Impact Rating

An impact rating table was drawn up for various activities taking place in Padre Isles for 1973, and which is included in Bryant, et al. (1973, pp 164-167). By examining changes that have been wrought through 1974, this table has been brought up to date (Table 21). Not all items that were listed last year are included in this year's table since some factors were not considered to be critical this year.

It can be seen in Table 21 that there have been an equal number of improvements, decreases in quality, and factors showing no change. Those factors which are all strongly favored and lead to an overall better quality environment for native wildlife are: dissolved oxygen, phosphate contents, BOD's, kinds of benthos, encrusting life, fish, increase in finer sediments, recolonization of spoil, numbers of reptiles, and perching birds. Those items showing degradation, mostly a result of climatic changes, are: rainfall, salinity, magnesium, benthic numbers, nekton numbers, sediment type, plant diversity, loss of marshes, increase in rabbits, and loss of wading birds. Only changes in sediment, plant diversity, and loss of marshes and wading birds can be attributed to man's direct interference. On the other hand many of the improvements are directly

TABLE 21. Impact ratings for two year's development--Padre Isles

Environmental Parameters	No Change	Improvement	Depreciation
WATER QUALITY			
Rainfall			X
pH	X		
Dissolved oxygen		X	
Salinities			X
Nitrogen	X		
Phosphates		X	
Calcium	X		
Magnesium			X
BOD		X	
Coliform counts	X		
Copper, iron, zinc	X		
AQUATIC BIOLOGY			
Phytoplankton	X		
Zooplankton	X		
Benthic populations			X
Benthic taxa		X	
Diversity	X		
Nekton			X
Epifauna		X	
Large fish		X	
SEDIMENTS			
Clay content		X	
Overall sediment type			X
TERRESTRIAL PLANTS			
Recolonization of spoil		X	
Diversity of plants			X
Dune vegetation	X		
Marshes			X
WILDLIFE			
Rodents			X
Reptiles		X	
Wading birds			X
Perching birds		X	
Diversity	X		
TOTAL NUMBER OF IMPACTS	10	10	10

related to man's influence. These improvements are: increased oxygen; decreased phosphates and BOD's; increase in epifaunas, reptiles, and perching birds.

Future improvement of environmental quality should be considered in looking for means to increase the numbers of bottom animals, reducing sand blowouts, increasing plant diversity and numbers of shore birds. All of these are more dependent upon natural environmental changes than man-made changes; thus, it is unlikely that future development can change overall quality immediately.

SUMMARY

1. Stations with greatest fluctuations in water quality are: Station 1, Golf Club Lake; Station 5, an inner residence canal; and Station 13, an inland dredged area near the utility complex. Two areas are dead end areas of stagnation.
2. All stations around the perimeter of the development were typical of normal bay conditions and showed no major disturbance factors.
3. Highest coliform counts were found at the Golf Club Lake, a transient pond near a sewage leak at a local motel, and the Galleon Bay residence canals. Six stations were characterized by very low coliform counts--all in open saline waters.
4. Low phytoplankton and zooplankton counts for all periods suggest that base of food pyramid may be bacteria and organic matter rather than plankton. Only August 1974 samples had high plankton counts normal for these coastal waters.

5. Low benthic counts were typical of summer months. Highest counts were at Station 7 near the hotel sewage treatment facility. Consistently low benthic counts were found at the ends of residence canals and near the shell loading bulkhead in Packery Channel--all areas of highest human impact.

6. Diversities are lower in summer than in winter in Padre Isles, and lowest diversities characterized the residence canals.

7. Nekton abundances were highest in undredged portions of Packery Channel and lowest in the Laguna Madre. Fish were more abundant in residence canals than elsewhere during summer months.

8. Largest concentrations of blue crabs were found in the Galleon Bay canals.

9. During periods of normal environmental adversity, large fish, crabs, and shrimp seek refuge in the canals which are deeper and more stable than the surrounding open waters.

10. Sediments have become more sandy; although clay contents have increased at the expense of silt-sized particles. It is not immediately apparent why these changes have taken place--construction is not suspected as a contributing factor.

11. Song birds have increased, while wading birds and birdlife in general have decreased. As wading birds are the normal inhabitants of this part of the barrier islands, an unnatural bird community is developing.

12. Small rodents, such as kangaroo rats, rice rats, and pygmy mice, have decreased in number, while rabbits, ground squirrels, and gophers (pest animals) have increased.

13. Several more species of plants were collected in August 1974 than during 1973. Many of these are new records for the region. However, overall plant diversity has decreased with the elimination of natural habitats and establishment of spoil-based land for residence construction.

14. Native soils are rapidly becoming obliterated and are being replaced by a single soil type, reclaimed dredge spoil, from construction of residence canals. Preliminary analyses indicate that the specially treated spoil may be a richer soil than existing surface soils. Data from the golf course construction shows that with proper fertilization soils are rich.

15. Ground water is normally quite hard and alkaline, thus is not best suited for many exotic plants. However, judicious selection of hardy tropical salt-resistant plants has permitted extensive use of ground water for irrigation.

16. Comparisons between baseline water quality data collected outisde of the project and data taken within Padre Isles boundaries show that nutrients are higher within Padre Isles channels--suggesting increases because of irrigation of surrounding lawns and golf course. Turbidity is less in Padre Isles waters than outside in open waters, because Padre Isles waters are protected from winds and continual mixing. Because of greater mixing in unprotected waters, dissolved oxygen is higher outside of Padre Isles.

17. Large differences in numbers of benthic animals exist between areas within and outside of Padre Isles. Typical samples from outside Padre Isles' boundaries contained over 1,000 animals per 1/25 m^2, whereas most samples taken inside Padre Isles contained only 10 to 25 animals per 1/25 m^2. No differences were observed between bacterial counts and nekton from control and project areas. Diversity indices were about the same for all stations

which suggests that low diversity is characteristic for the whole region regardless of development.

18. Plant diversity and cover was greater on control areas than within Padre Isles--showing a definite impact of development on natural plant communities.

19. Vegetation on spoil islands not treated with native range compost and outside of Padre Isles was strikingly different from that on Padre Isles reclaimed spoil. Plant life was almost as diverse and abundant on treated spoil as it was on nearby native range, even though the spoil was deposited only a few years ago. On the other hand, spoil thrown up many years ago from dredging the Intracoastal Waterway and Packery Channel was covered by only a few sparse plants.

20. An overall impact analysis for two years of construction and development on Padre Isles revealed that an equal number of items showed no change, decrease in quality, and improvement. Those factors improving were dissolved oxygen; phosphates; BOD's; benthic types; encrusting animals; fish; increases in finer sediments, numbers of reptiles, and numbers of perching birds; and recolonization of spoil. Those factors decreasing in quality were rainfall, salinity, magnesium concentration, benthic numbers, nekton numbers, sediment type, plant diversity, increase in rabbits, and loss of marshes and wading birds.

21. Future improvement in environmental quality should concentrate on saving the oak community, dune community, increasing bottom animals, reducing sand blowouts, increasing plant diversity, and encouraging more shore birds.

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APPENDIX I

DESCRIPTION OF STATION LOCATIONS--PADRE ISLES

TABLES 1 - 11

DESCRIPTION OF STATION LOCATIONS--PADRE ISLES

Station Number	Description
1	North end of Golf Club Lake
2	State Highway bridge over Packery Channel
3	Dredged portion of Packery Channel at County Park
4	Old dredged area between golf course and utility complex road
5	New residence canal just south of utility road
6	Intermittent pond in back of Tradewinds Motel
7	Near outfall from sewage plant at hotel area (Packery Channel terminus)
8	By sewage plant at bend of Galleon Bay main residence canal
9	Galleon Bay canal. For first three sample trips, half way up canal and on August 1974 trip, at end by Country Club
10	Terminal end of secondary residence canal at Galleon Bay
11	Wide entrance to Galleon Bay canal
12	Intracoastal Waterway at entrance to Galleon Bay
13	Inland of utility complex island, shallow dredged area
14	At corner of utility complex island
15	Dredged portion of Packery Channel, adjacent to shell barge dock

redox potential millivolts

Eh field 46480

TABLE 1. Water quality data--Padre Isles, January and September 1973

Station	Month 1973	Depth m	Temperature °C	DO ppm	pH	Eh mv	Turbidity JTU	H_2S ppm	Conductivity μ-mhos	Salinity ‰	Cl^- ‰	$NO_3^-+NO_2^-$ ppm	PO_4^{-3} ppm	Ca ppm	Mg ppm	Mg/Ca	Cu ppm	Zn ppm	Fe ppm
1S*	January	...	10.0	5.6	7.8	+500	88	0.1	16,000	9.6	5.4	6.0	1.09	107	140	1.30	...	...	...
	September	...	28.0	3.1	7.9	+510	10		15,000	9.1	5.0	3.5	0.90	...	...	...	...	...	...
1B	January	0.91	...	...	...	...	...	...	...	...	...	5.0	1.18	107	133	1.24	...	...	...
	September	0.61	no data																
2S	January	...	10.1	8.4	8.6	+520	8	0.1	42,000	27.5	15.1	3.9	0.65	220	1067	4.85	...	...	...
	September	...	29.0	4.0	7.9	+590	10	...	36,000	23.1	12.8	5.0	0.35	94	1299	13.50	0.052	0.068	0.06
2B	January	1.83	9.5	8.3	8.5	+520	...	...	43,000	28.2	15.6	5.5	0.70	230	1400	6.09	...	...	...
	September	2.13	28.0	7.9	...	+600	...	...	41,000	26.7	14.8	4.5	0.49	96	1084	11.30	0.060	0.097	0.03
3S	January	...	11.5	9.2	8.2	+500	28	0.1	41,000	26.7	14.8	5.1	0.40	220	1200	5.45	...	...	...
	September	...	29.5	4.3	7.9	+550	15	...	40,000	26.0	14.5	3.0	0.30	95	1004	10.60	0.013	0.129	0.07
3B	January	0.91	no data																
	September	0.91	no data																
4S	January	...	12.8	8.9	8.7	+400	8	0.1	4,900	2.6	1.2	4.5	0.61	92	136	1.48	...	...	...
	September	...	no samples																
4B	January	0.61	no data																
	September	...	no samples																
5S	January	...	11.6	10.0	8.6	+260	18	0.1	39,000	25.3	14.0	4.9	0.85	230	1200	5.22	...	...	...
	September	...	30.0	3.9	7.9	+625	5	...	39,000	25.3	14.0	4.0	0.30	103	1091	10.60	0.091	0.123	0.03
5B	January	1.22	...	...	...	...	...	...	...	...	...	...	0.95	...	...	...	...	...	...
	September	0.91	no data																
6S	January	...	12.3	8.1	8.7	+390	22	0.1	2,100	1.1	0.6	6.0	0.91	70	63	0.90	...	...	...
	September	...	no data																
6B	January	1.22	no data																
	September	0.02	no data																
7S	January	...	10.8	7.9	8.6	+650	5	0.1	42,000	27.5	15.1	5.0	0.95	220	1200	5.45	...	...	...
	September	...	28.0	2.7	7.9	+560	20	...	31,000	19.2	10.9	4.0	0.30	85	872	10.30	0.070	0.055	0.07
7B	January	0.91	no data																
	September	1.06	no data																
8S	January	...	10.1	7.0	7.9	+450	11	0.1	42,000	27.5	15.1	5.1	0.61	223	1400	6.28	...	...	...
	September	...	27.0	2.2	7.9	+525	4	...	39,000	25.3	14.0	4.0	0.39	93	998	10.50	0.102	0.068	0.06
8B	January	2.74	10.4	3.8	7.9	+450	...	...	42,000	27.5	15.1	4.9	0.55	233	1175	5.04	...	...	...
	September	3.05	27.5	1.5	7.9	+510	...	...	38,000	24.6	13.6	4.2	0.35	93	1033	11.20	0.092	0.075	0.05

TABLE 1. (continued)

Station	Month 1973	Depth m	Temperature °C	DO ppm	pH	Eh mv	Turbidity JTU	H_2S ppm	Conductivity µ-mhos	Salinity °/oo	Cl^- °/oo	$NO_3^- + NO_2^-$ ppm	PO_4^{-3} ppm	Ca ppm	Mg ppm	Mg/Ca	Cu ppm	Zn ppm	Fe ppm
9S	January	...	11.0	7.2	8.3	+560	10	0.1	37,000	23.8	13.2	5.0	0.49	223	1167	5.23	...	...	...
	September	...	28.5	2.6	7.9	+500	3	...	39,000	25.3	14.0	4.0	0.40	93	963	10.60	0.114	0.071	0.051
9B	January	3.35	10.5	6.6	8.2	+620	...	...	43,000	28.2	15.6	6.0	0.45	243	1267	5.21	...	...	...
	September	3.20	27.5	2.1	7.9	+510	...	...	40,000	25.7	14.2	2.0	0.45	93	1056	11.30	0.180	0.094	0.052
10S	January	...	11.0	7.3	8.3	+580	10	0.1	40,500	26.3	14.5	3.0	0.40	233	1067	4.58	...	...	...
	September	...	28.5	2.1	7.9	+520	3	...	41,000	26.7	14.8	4.0	0.35	88	999	11.40	0.114	0.079	0.020
10B	January	2.74	10.5	7.0	8.5	+560	...	...	41,000	26.7	14.8	4.1	0.35	233	1067	4.58	...	...	...
	September	3.05	27.0	1.9	7.9	+510	...	...	41,000	26.7	14.8	4.5	0.45	92	1041	11.30	0.138	0.087	0.030
11S	January	...	10.5	7.9	8.4	+380	4	0.1	40,000	26.0	14.4	3.5	0.40	233	1067	4.52	...	...	...
	September	...	29.5	2.7	7.9	+525	10	...	41,000	26.7	14.8	4.0	0.40	94	1086	11.60	0.148	0.116	0.050
11B	January	2.44	10.0	7.8	8.5	+420	...	...	40,500	26.3	14.5	4.0	0.35	236	1200	5.08	...	...	...
	September	2.74	28.9	1.8	7.8	+550	...	...	40,000	26.0	14.4	4.3	0.45	94	1076	10.80	0.137	0.099	0.058
12S	January	...	10.5	7.9	8.5	+480	10	0.1	43,500	28.5	15.7	4.0	0.25	220	1167	5.30	...	...	...
	September	...	27.5	2.7	7.9	+500	5	...	40,050	26.3	14.6	4.0	0.40	97	1125	11.60	0.150	0.092	0.068
12B	January	3.20	10.5	8.0	8.4	+450	...	...	43,000	28.2	15.6	3.9	0.15	233	1633	7.01	...	...	...
	September	3.50	28.5	2.0	7.8	+200	...	...	41,000	26.7	14.8	3.9	0.45	95	1079	11.40	0.179	0.082	0.072
13S	January	...	10.3	8.7	8.6	+580	18	0.1	43,000	28.2	15.6	5.0	0.20	190	2133	11.23	...	...	...
	September	...	30.0	2.3	7.8	+200	5	...	38,000	24.60	13.6	3.5	0.35	99	1030	10.40	0.099	0.092	0.049
13B	January	3.96	10.0	8.3	8.5	+590	...	...	43,500	28.5	15.7	4.2	0.15	190	1300	6.84	...	...	...
	September	3.66	28.5	1.5	7.9	+230	...	...	43,000	28.2	15.6	4.0	0.30	99	1087	10.90	0.081	0.090	0.046
14S	January	...	11.0	8.4	8.5	+450	8	0.1	43,500	28.5	15.7	4.0	0.35	146	1533	10.50	...	...	...
	September	...	32.0	3.1	7.9	+150	2	...	40,000	26.0	14.4	3.0	0.30	98	1107	11.30	0.101	0.124	0.046
14B	January	2.74	10.4	8.1	8.5	+430	...	...	43,500	28.5	15.7	4.5	0.20	190	1333	8.07	...	...	...
	September	3.81	...	...	...	...	...	...	...	...	...	5.0	0.39	101	1123	11.20	0.091	0.137	0.038
15S	January	...	11.0	8.1	8.4	+390	6	0.1	43,500	28.5	15.7	4.5	0.12	150	1133	7.50	...	...	...
	September	...	27.0	1.9	7.9	+650	5	...	40,000	26.0	14.4	4.0	0.35	96	1130	11.80	0.104	0.126	0.036
15B	January	2.44	11.0	7.6	8.4	+400	...	...	43,000	28.2	15.6	5.1	0.15	176	1233	7.25	...	...	...
	September	3.50	28.5	2.0	7.9	+625	..	...	41,000	26.7	14.8	4.5	0.30	94	1089	11.60	0.125	0.149	0.040

*S = surface
B = bottom

TABLE 2. Water quality data--Padre Isles, February and August 1974

Eh H_2S

Station	Month 1974	Depth m	Temperature °C	DO ppm	pH	Turbidity JTU	Conductivity µ-mhos	Salinity ⁰/oo	Cl⁻ ⁰/oo	$NO_3^-+NO_2^-$ ppm	PO_4^{-3} ppm	Ca ppm	Mg ppm	Mg/Ca	Cu ppm	Zn ppm	Fe ppm
1S*	February	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	August	...	...	...	...	30	...	...	...	6.60	0.15	64	69	1.08	0.3	0	0
1B	February	0.60	19.5	7.4	7.8	70	4,500	2.5	1.2	0.19	1.85	60	875	14.58	0.5	...	...
	August	0.70	28.5	7.5	8.9	35	1,600	1.0	1.8	8.80	0.43	66	60	0.91	0.1	0	0
2S	February	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	August	...	...	...	...	22	56,000	37.0	20.5	3.96	0.13	229	2000	8.73	1.5	0.20	0.1
2B	February	3.92	20.0	6.6	7.8	10	34,500	21.2	11.8	0.48	0.05	158	1205	7.63	1.2	...	...
	August	0.60	30.0	6.8	8.4	22	56,000	37.0	20.5	3.96	0.13	229	2000	8.73	1.5	0.20	0.1
3S	February	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	August	...	30.0	6.5	8.4	11	59,000	39.5	22.0	2.20	0.17	254	2030	7.99	1.6	0.26	0.1
3B	February	2.61	21.0	5.9	7.9	15	36,000	22.6	12.5	0.65	0.04	167	1232	7.33	1.4	...	...
	August	0.50	30.0	6.2	8.4	12	59,000	39.5	22.0	5.72	0.05	233	2000	8.58	1.4	0.30	1.0
4S	February	No station															
	August	...	...	...	...	12	...	...	...	3.08	0.25	175	1940	11.08	1.1	0.16	0.1
4B	February	No station															
	August	0.40	29.0	5.8	8.3	35	51,000	33.5	18.5	2.64	0.23	188	2020	10.74	1.2	0.11	0.2
5S	February	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	August	...	...	...	...	35	57,000	38.0	21.0	2.20	0.13	207	2120	10.24	1.2	0.20	1.2
5B	February	3.92	20.5	6.8	7.9	25	30,000	18.5	10.2	0.49	0.23	149	1248	8.38	1.1	...	...
	August	0.20	28.0	6.6	8.2	35	57,000	38.0	21.0	2.20	0.13	207	2120	10.24	1.2	0.20	1.2
6S	February	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	August	Station eliminated															
6B	February	0.10	...	...	...	...	...	...	...	0.20	0	42	697	16.60	0	...	...
	August	Station eliminated															
7S	February	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	August	...	...	...	...	25	...	...	...	2.64	0.08	190	2120	11.16	1.1	0.14	0.2
7B	February	1.00	19.5	6.5	7.9	10	33,500	20.8	11.5	0.37	0.04	168	1179	7.02	1.5	...	...
	August	0.30	29.0	7.1	8.2	20	53,000	35.0	19.3	4.40	0.08	221	1880	8.51	1.1	0.04	0.2
8S	February	...	...	...	...	...	...	...	...	0.37	0.08	178	1180	6.63	1.4	...	...
	August	...	29.0	5.9	8.4	5	52,000	34.5	18.9	3.52	0.08	252	2080	8.25	1.1	0.13	0.6
8B	February	2.62	20.0	5.1	7.8	15	35,000	22.0	12.2	0.55	0.09	173	1177	6.80	1.6	...	...
	August	2.00	29.0	5.6	8.4	8	52,000	34.5	18.9	9.68	0.15	250	2100	8.40	1.3	0.15	0.5

TABLE 2 (continued)

Sta-tion	Month 1974	Depth m	Temper-ature °C	DO ppm	pH	Turbidity JTU	Conduc-tivity µ-mhos	Salinity $^{0}/oo$	Cl^- $^{0}/oo$	$NO_3^-+NO_2^-$ ppm	PO_4^{-3} ppm	Ca ppm	Mg ppm	Mg/Ca	Cu ppm	Zn ppm	Fe ppm
9S	February	...	...	...	...	...	...	...	...	0.52	0.11	152	1152	7.58	1.3	...	...
	August	...	29.0	5.7	8.4	...	54,000	35.7	19.6	...	...	252	1980	7.86	1.2	0.19	0.4
9B	February	2.80	20.5	0.5	7.9	15	36,000	22.6	12.5	0.70	0.07	156	1152	7.38	1.4	...	...
	August	3.60	29.0	5.3	8.4	9	53,000	35.0	19.3	2.64	0.09	...	...	...	...	...	...
10S	February	...	...	...	...	...	...	...	...	0.60	0.07	162	1180	7.28	1.4	...	...
	August	...	29.5	6.2	8.4	12	58,000	39.0	21.5	2.64	0.08	247	1960	7.94	1.5	0.12	0.5
10B	February	2.00	19.0	5.2	7.9	10	32,500	20.2	11.2	0.71	0.12	174	1155	6.64	1.4	...	...
	August	2.20	29.5	5.2	8.5	5	60,000	40.5	22.2	2.64	0.06	245	1890	7.71	1.2	0.16	0.4
11S	February	...	...	...	...	...	...	...	...	0.48	0.12	166	1155	6.96	1.3	...	...
	August	...	29.0	6.4	8.4	10	58,000	39.0	21.5	3.52	0.01	253	1880	7.43	1.1	0.16	0.7
11B	February	2.00	19.0	5.3	7.8	15	34,000	20.2	11.7	0.52	0.13	165	1236	7.49	1.5	...	...
	August	2.60	29.0	5.9	8.4	10	58,500	39.2	21.7	3.08	0.15	241	1850	7.68	1.0	0.20	0.8
12S	February	...	19.0	6.2	7.9	...	32,000	19.8	11.0	0.38	0.10	165	1212	7.34	1.4	...	...
	August	...	29.0	5.4	8.0	6	48,000	31.2	17.2	7.92	0.08	246	1810	7.36	1.3	0.19	0.6
12B	February	4.00	18.0	6.4	7.8	10	34,000	20.2	11.7	0.73	0.03	167	1202	7.20	1.1	...	...
	August	2.30	28.0	5.4	7.4	10	51,000	33.5	18.5	5.28	0.13	237	1880	7.93	1.3	0.21	0.6
13S	February	...	19.5	5.6	7.8	...	33,000	20.5	11.3	0.47	0.08	158	1202	7.73	1.1	...	...
	August	...	...	...	...	15	...	...	...	2.64	0.05	247	1820	7.37	0.9	0.20	0.7
13B	February	3.60	17.5	4.7	7.8	15	33,000	20.5	11.3	2,75	5.00	287	1348	4.70	2.5	...	...
	August	0.60	29.0	6.8	8.4	12	57,000	38.0	21.0	4.40	0.02	254	1920	7.56	1.1	0.19	0.5
14S	February	...	20.0	6.1	7.8	...	34,000	20.2	11.7	0.49	0.08	165	1259	7.63	1.1	...	...
	August	...	29.0	6.2	8.0	8	42,000	26.9	14.8	5.28	0.10	234	1800	7.69	0.9	0.21	0.6
14B	February	4.40	19.5	6.2	7.8	20	34,000	20.2	11.7	0.25	0.13	154	1242	8.06	1.2	...	...
	August	3.60	28.0	5.3	8.0	5	40,000	25.4	14.0	3.08	0.06	242	1770	7.31	0.8	0.23	0.5
15S	February	...	...	...	...	...	...	...	...	0.40	0.05	174	1273	7.32	1.4	...	...
	August	...	29.5	6.3	8.4	9	57,500	38.2	21.2	2.20	0.09	234	1710	7.31	1.1	0.31	0.6
15B	February	1.80	19.0	5.2	7.9	15	37,000	23.3	12.8	0.60	0.10	201	1195	5.94	1.5	...	...
	August	1.60	29.5	5.8	8.4	8	58,000	39.0	21.5	1.76	0,06	225	1710	7.60	1.0	0.29	0.5

*S = surface
B = bottom

TABLE 3. Percents sand, silt, and clay as determined by sediment analyses--Padre Isles area--1973

Station Number	Month 1973	% Sand	% Silt	% Clay	Sediment Type
1	Jan.	95.0	3.0	2.0	Sand
	Sept.	89.2	7.6	3.2	Sand
2	Jan.	72.5	24.0	3.5	Silty Sand
	Sept.	86.2	8.4	5.4	Sand
3	Jan.	95.5	1.5	3.0	Sand
	Sept.	94.6	1.6	3.8	Sand
4	Jan.	97.5	0.5	2.0	Sand
5	Jan.	86.0	11.0	3.0	Sand
6	Jan.	95.5	1.5	3.0	Sand
	Sept.	94.8	2.6	2.6	Sand
7	Jan.	60.4	34.4	5.2	Silty Sand
	Sept.	93.2	4.4	2.4	Sand
8	Jan.	88.8	4.4	6.8	Sand
	Sept.	78.0	9.8	12.2	Clayey Sand
9	Jan.	62.0	29.6	8.4	Silty Sand
	Sept.	75.4	9.8	14.8	Clayey Sand
10	Jan.	64.4	27.2	8.4	Silty Sand
	Sept.	96.8	1.6	1.6	Sand
11	Jan.	81.0	13.0	6.0	Sand
	Sept.	90.4	5.8	3.8	Sand
12	Jan.	91.2	2.4	6.4	Sand
	Sept.	90.4	4.8	4.8	Sand
13	Jan.	84.4	10.0	5.6	Sand
	Sept.	94.6	2.8	2.6	Sand
14	Jan.	68.8	22.8	8.4	Silty Sand
	Sept.	86.0	10.0	4.0	Sand
15	Jan.	72.8	18.4	8.8	Silty Sand
	Sept.	90.2	4.4	5.4	Sand

TABLE 4. Percents sand, silt, and clay as determined by sediment analyses--Padre Isles area--February 1974

Station Number	% Sand	% Silt	% Clay	Sediment Type	Change from 1973
1	95.6	0.4	4.0	Sand	More clay
2	96.2	0	3.8	Sand	Less clay
3	93.6	0.4	6.0	Sand	More clay
4	No sample				
5	98.4	0	1.6	Sand	Less clay
6	90.2	4.8	5.0	Sand	Much less silt
7	93.0	1.6	5.4	Sand	More clay
8	95.2	0	4.8	Sand	Much less clay and silt
9	88.4	4.6	7.0	Sand	Much more sand, far less silt
10	92.2	1.0	6.8	Sand	Less silt, more clay
11	87.4	4.4	8.2	Sand	More clay
12	82.2	7.6	10.2	Clayey Sand	Much more clay
13	92.8	2.6	4.6	Sand	More clay
14	88.2	3.8	8.0	Sand	More clay, less silt
15	91.0	1.4	7.6	Sand	More clay, less silt

TABLE 5. Benthic invertebrate populations (1/25 m^2)

Station Number	Number of Individuals				Number of Taxa				Diversity Index			
	1973		1974		1973		1974		1973		1974	
	Jan.	Sept.	Feb.	Aug.	Jan.	Sept.	Feb.	Aug.	Jan.	Sept.	Feb.	Aug.
1	54	2	990	450	3	1	9	2	0.48	0	0.19	0.08
2	223	6	25	154	10	1	6	7	0.27	0	0.47	0.53
3	656	...	896	23	8	...	8	2	0.35	...	0.28	0.07
4	271	...	...	3	5	...	...	1	0.30	...	...	0
5	104	...	7	28	3	...	3	4	0.08	...	0.35	0.31
6	38	14	1489	...	3	4	4	...	0.29	0.23	0.12	...
7	307	110	14	240	4	2	3	4	0.06	0.05	0.27	0.14
8	37	6	2	54	4	4	2	5	0.47	0.54	0.28	0.41
9	1	14	2	106	1	4	2	3	0	0.54	0.28	0.17
10	0	1017	217	26	0	3	4	4	0	0.02	0.14	0.23
11	316	132	151	1	8	3	9	1	0.17	0.04	0.23	0
12	162	29	54	66	9	2	6	10	0.63	0.24	0.64	0.82
13	24	14	3	7	6	6	1	5	0.62	0.59	0	0.69
14	38	170	21	3	7	2	7	2	0.59	0.03	0.66	0.25
15	1	26	32	9	1	4	9	1	0	0.45	0.70	0
Average	149	128	279	84	5	3	5	4	0.29	0.23	0.33	0.26

TABLE 6. Nektonic and epibenthic organisms collected in waters associated with Padre Isles Development, September 1973

Sta-tions	Sampling Device	Species	Number of Specimens	Sizes
2	Seine	*Callinectes sapidus* Rathbun Blue crab	4	40 mm x 75 mm 19 mm x 35 mm 10 mm x 17 mm 8 mm x 14 mm
		Penaeus aztecus Ives Brown shrimp	251	1- 60 mm 2- 50 mm 16- 35 mm to 45 mm 30- 25 mm to 30 mm 202- 10 mm to 20 mm
		Clibanarius vittatus (Bosc) Striped hermit crab	1	1- 55 mm 1- 40 mm 4- 30 mm
		In *Thais haemastoma floridana* (Conrad) shells	3	
		In *Polinices duplicatus* (Say) shells	2	
		Fundulus grandis Baird and Girard Gulf killifish	58	12- 25 mm
		Fundulus similis (Baird and Girard) Longnose killifish	2	1- 30 mm 1- 35 mm
		Selar crumenophthalmus (Bloch) Bigeye scad	4	4- 25 mm to 42 mm
		Sphoeroides parvus Shipp and Yerger Least puffer	1	1- 18 mm
		Gobionellus boleosoma (Jordan and Gilbert) Darter goby	1	1- 52 mm

TABLE 6. (continued)

Sta- tions	Sampling Device	Species	Number of Specimens	Sizes
3	Seine	*Penaeus aztecus* Ives Brown shrimp	1	1- 44 mm
		Clibanarius vittatus (Bosc) Striped hermit crab In *Thais haemastoma floridana* (Conrad) shells	2	1- 45 mm 1- 30 mm
		Fundulus grandis Baird and Girard Gulf killifish	4	4- 12 mm to 30 mm
		Fundulus similis (Baird and Girard) Longnose killifish	1	1- 48 mm
		Anchoa mitchilli (Valenciennes) Bay anchovy	4	4- 20 mm to 60 mm
		Selar crumenophthalmus (Bloch) Bigeye scad	2	1- 35 mm 1- 45 mm
		Sphoeroides parvus Shipp and Yerger Least puffer	1	1- 15 mm
8	Trawl	*Callinectes sapidus* Rathbun Blue crab	1	70 mm x 131 mm
		Lagodon rhomboides (Linnaeus) Pinfish	3	1- 75 mm 1- 94 mm 1- 95 mm
		Micropogon undulatus (Linnaeus) Atlantic croaker	4	4- 91 mm

TABLE 6. (continued)

Sta-tions	Sampling Device	Species	Number of Specimens	Sizes
11	Trawl	*Callinectes sapidus* Rathbun Blue crab	1	70 mm x 140 mm
		Lolliguncula brevis (Blainville) Squid	3	2- 45 mm 1- 55 mm
		Lagodon rhomboides (Linnaeus) Pinfish	3	1- 4 mm 1- 92 mm 1- 101 mm
		Micropogon undulatus (Linnaeus) Atlantic croaker	2	1- 108 mm 1- 110 mm
		Anchoa mitchilli (Valenciennes) Bay anchovy	94	94- 30 mm to 40 mm
		Cynoscion arenarius Ginsburg Sand seatrout	1	1- 154 mm
		Megalops atlantica Valenciennes Tarpon	1 scale	
12	Trawl	*Callinectes sapidus* Rathbun Blue crab	1	1- 110 mm
		Anchoa mitchilli (Valenciennes) Bay anchovy	1	1- 44 mm
13	Trawl	*Callinectes sapidus* Rathbun Blue crab	2	70 mm x 140 mm 50 mm x 80 mm

TABLE 6. (continued)

Sta-tions	Sampling device	Species	Number of Specimens	Sizes
13 (continued)		*Lolliguncula brevis* (Blainville) Squid	6	6- 80 mm
		Penaeus aztecus Ives Brown shrimp	1	1- 110 mm
		Micropogon undulatus (Linnaeus) Atlantic croaker	9	9- 85 mm to 125 mm
		Lagodon rhomboides (Linnaeus) Pinfish	1	1- 85 mm
		Anchoa mitchilli (Valenciennes) Bay anchovy	2	1- 42 mm 1- 44 mm
14	Trawl	*Lolliguncula brevis* (Blainville) Squid	3	1- 80 mm 2- 40 mm
		Palaemonetes pugio Holthuis Grass shrimp	2	2- 30 mm
		Lagodon rhomboides (Linnaeus) Pinfish	2	1- 94 mm 1- 96 mm
		Micropogon undulatus (Linnaeus) Atlantic croaker	3	1- 100 mm 1- 104 mm 1- 110 mm
		Synodus foetens (Linnaeus) Inshore lizardfish	1	1- 240 mm
		Opsanus beta (Goode and Bean) Gulf toadfish	1	1- 50 mm

TABLE 7. Nektonic and epibenthic organisms collected in waters associated with Padre Isles Development, February and August 1974

Stations	Sampling Device	Species	Number of Specimens	Sizes
FEBRUARY				
2	Seine	*Clibanarius vittatus* (Bosc)		
		Striped hermit crab		
		In *Polinices duplicatus* (Say) shell	1	40 mm (length)
		In *Thais haemastoma floridana* (Conrad) shell	1	45 mm (length)
		Callinectes sapidus Rathbun	1	15 mm x 10 mm
		Blue crab		
		Penaeus aztecus Ives	2	1 at 20 mm
		Brown shrimp		1 at 29 mm
		Fundulus grandis Baird and Girard	7	1 at 22 mm
		Gulf killifish		1 at 23 mm
				1 at 28 mm
				1 at 30 mm
				2 at 32 mm
				1 at 35 mm
		Fundulus similis (Baird and Girard)	1	65 mm
		Longnose killifish		
		Micropogon undulatus (Linnaeus)	3	1 at 17 mm
		Atlantic croaker		1 at 18 mm
				1 at 23 mm

TABLE 7. (continued)

Stations	Sampling Device	Species	Number of Specimens	Sizes
AUGUST				
3	Trawl	*Crassostrea virginica* (Gmelin)	1	Juvenile
		On *Thais* shell		
		Anachis avara semiplicata (Stearns)	4	1 at 5 mm
		Dove shell		2 at 9 mm
				1 at 11 mm
		Clibanarius vittatus (Bosc)		1 at 30 mm
		Striped hermit crab		1 at 35 mm
		In *Polinices duplicatus* (Say) shell	1	1 at 37 mm
		In *Busycon perversum* (Linnaeus) shell	2	1 at 40 mm
		In *Thais haemaestoma floridana* (Conrad) shell	8	1 at 47 mm
		In *Murex pomum* (Gmelin) shell	1	1 at 50 mm
				2 at 60 mm
				1 at 62 mm
				1 at 68 mm
				1 at 70 mm
				1 at 73 mm
		Menippe mercenaria (Say)	1	12 mm x 15 mm
		Stone crab		
		Micropanope xanthiformis (Milne Edwards)	1	8 mm x 10 mm
		Mud crab		
		Cirolana parva (Hansen)	1	1 at 14 mm
		Planktonic isopod		

TABLE 7. (continued)

Sta- tions	Sampling Device	Species	Number of Specimens	Sizes
3 (continued)		*Orthopristis chrysoptera* (Linnaeus) Pigfish	10	1 at 105 mm 1 at 106 mm 1 at 110 mm 2 at 116 mm 1 at 118 mm 1 at 120 mm 1 at 125 mm 1 at 130 mm 1 at 154 mm
		Lagodon rhomboides (Linnaeus) Pinfish	8	1 at 102 mm 1 at 104 mm 1 at 107 mm 1 at 108 mm 1 at 115 mm 1 at 118 mm 1 at 126 mm 1 at 130 mm
		Leiostomus xanthurus Lacépède Spot	15	1 at 126 mm 2 at 129 mm 1 at 135 mm 2 at 145 mm 3 at 151 mm 2 at 153 mm 1 at 163 mm 2 at 174 mm 1 at 190 mm
		Eucinostomus argenteus Baird and Girard Spotfin mojarra	3	1 at 57 mm 1 at 70 mm 1 at 72 mm

TABLE 7. (continued)

Sta-tions	Sampling Device	Species	Number of Specimens	Sizes
3 (continued)		*Symphurus diomedianus* (Goode and Bean) Spottedfin tonguefish	1	1 at 172 mm
		Chilomycterus schoepfi (Walbaum) Striped burrfish	1	1 at 115 mm
		Synodus foetens (Linnaeus) Inshore lizardfish	1	1 at 240 mm
		Opsanus beta (Goode and Bean) Gulf toadfish	1	1 at 120 mm
7	Seine	*Micropanope xanthiformis* (Milne Edwards) Mud crab	1	6 mm x 8 mm
		Lagodon rhomboides (Linnaeus) Pinfish	1	1 at 57 mm
		Eucinostomus argenteus Baird and Girard Spotfin mojarra	2	1 at 51 mm 1 at 63 mm
		Fundulus similis (Baird and Girard) Longnose killifish	6	1 at 42 mm 1 at 82 mm 1 at 85 mm 1 at 87 mm 1 at 91 mm 1 at 100 mm
		Mugil cephalus (Linnaeus) Striped mullet	1	1 at 82 mm

TABLE 7. (continued)

Sta-tions	Sampling Device	Species	Number of Specimens	Sizes
7 (continued)		*Adinia xenica* (Jordan and Gilbert) Diamond killifish	1	1 at 55 mm
FEBRUARY				
8	Trawl	*Anchoa mitchilli* (Valenciennes) Bay anchovy	137	1 at 23 mm 5 at 25 mm 3 at 26 mm 2 at 27 mm 6 at 28 mm 3 at 30 mm 7 at 31 mm 9 at 32 mm 6 at 33 mm 1 at 34 mm 15 at 35 mm 10 at 36 mm 11 at 37 mm 8 at 38 mm 4 at 39 mm 15 at 40 mm 1 at 41 mm 3 at 42 mm 4 at 43 mm 4 at 44 mm 12 at 45 mm 1 at 46 mm 3 at 48 mm 1 at 49 mm 1 at 50 mm 1 large (mangled)

TABLE 7. (continued)

Sta-tions	Sampling Device	Species	Number of Specimens	Sizes
AUGUST				
8	Trawl	*Aequipecten amplicostatus* (Dall) Bay scallop	2 valves	
		Crassostrea virginica (Gmelin) Eastern oyster	4 valves	
		Chione cancellata (Linnaeus) Cross-barred venus	1 valve	
		Lucina floridana Conrad Florida lucina	1 valve	
		Polinices duplicatus (Say) Shark's eye	1 (old)	
		Menippe mercenaria (Say) Stone crab	1	44 mm x 58 mm
		Penaeus aztecus Ives Brown shrimp	1	1 at 85 mm
		Barnacles	3	Small
		Lagodon rhomboides (Linnaeus) Pinfish	1	1 at 140 mm
		Sphoeroides testudineus (Linnaeus) Checkered puffer	1	1 at 60 mm

TABLE 7. (continued)

Sta-tions	Sampling Device	Species	Number of Specimens	Sizes
8 (continued)		*Leiostomus xanthurus* (Lacépède) Spot	10	2 at 110 mm 1 at 123 mm 1 at 125 mm 1 at 126 mm 1 at 131 mm 1 at 132 mm 1 at 135 mm 1 at 151 mm 1 at 155 mm
		Paralichthys lethostigma Jordan and Gilbert Southern flounder	1	1 at 163 mm
		Citharichthys spilopterus Günther Bay whiff	7	1 at 70 mm 1 at 75 mm 1 at 77 mm 1 at 78 mm 1 at 90 mm 1 at 100 mm 1 at 104 mm
FEBRUARY				
11	Trawl	*Callinectes sapidus* Rathbun Blue crab	1	100 mm x 52 mm
		Micropogon undulatus (Linnaeus) Atlantic croaker	2	1 at 25 mm 1 at 115 mm
		Lagodon rhomboides (Linnaeus) Pinfish	2	2 at 100 mm

TABLE 7. (continued)

Sta-tions	Sampling Device	Species	Number of Specimens	Sizes
11 (continued)		*Anchoa mitchilli* (Valenciennes) Bay anchovy	20	2 at 32 mm 1 at 33 mm 1 at 35 mm 3 at 38 mm 2 at 40 mm 3 at 42 mm 2 at 43 mm 1 at 44 mm 2 at 45 mm 1 at 46 mm 1 at 50 mm 1 at 52 mm
AUGUST				
11	Trawl	*Orthopristis chrysoptera* (Linnaeus) Pigfish	1	1 at 110 mm
		Opsanus beta (Goode and Bean) Gulf toadfish	2	1 at 150 mm 1 at 194 mm
		Citharichthys spilopterus Günther Bay whiff	1	1 at 80 mm
FEBRUARY				
12	Trawl	*Anchoa mitchilli* (Valenciennes) Bay anchovy	4	1 at 38 mm 2 at 40 mm 1 at 43 mm

TABLE 7. (continued)

Stations	Sampling Device	Species	Number of Specimens	Sizes
12 (continued)		*Selar crumenopthalmus* (Bloch) Bigeye scad	1	1 at 32 mm
		Micropogon undulatus (Linnaeus) Atlantic croaker	1	1 at 22 mm
AUGUST				
12	Trawl	*Anachis avara semiplicata* (Stearns) Dove shell	1 (live)	
		Cirolana parva (Hansen) Planktonic isopod	1	11 mm
		Diopatra cuprea Claparede Worm tubes	1 1	29 mm 45 mm
		Libinia dubia H. Milne Edwards Spider crab	1	48 mm x 40 mm
		Pagurus pollicaris Say Hermit crab In *Polinices duplicatus* (Say) shells covered with the hydroid *Hydractinia echinatus*	2	
		Pagurus sp. Hermit crab In *Nassarius vibex* (Say) shell	1	
		Hydroids		

TABLE 7. (continued)

Sta-tions	Sampling Device	Species	Number of Specimens	Sizes
12 (continued)		*Orthopristis chrysoptera* (Linnaeus) Pigfish	1	1 at 145 mm
		Chilomycterus schoepfi (Walbaum) Striped burrfish	3	1 at 88 mm 1 at 95 mm 1 at 100 mm
		Synodus foetens (Linnaeus) Inshore lizardfish	1	1 at 202 mm
		Chaetodipterus faber (Broussonet) Atlantic spadefish	3	1 at 47 mm 1 at 76 mm 1 at 92 mm
FEBRUARY				
13	Trawl	*Anchoa mitchilli* (Valenciennes) Bay anchovy	26	1 at 28 mm 2 at 30 mm 3 at 33 mm 1 at 35 mm 4 at 40 mm 3 at 43 mm 8 at 45 mm 1 at 48 mm 3 at 55 mm
14	Trawl	Atherinidae (Not *Menidia beryllina* or *Membras martinica*) Silversides	7	6 at 30 mm 1 at 33 mm

TABLE 7. (continued)

Sta-tions	Sampling Device	Species	Number of Specimens	Sizes
14 (continued)		*Anchoa mitchilli* (Valenciennes) Bay anchovy	68	1 at 24 mm 1 at 27 mm 6 at 30 mm 4 at 32 mm 4 at 34 mm 11 at 35 mm 2 at 36 mm 2 at 37 mm 3 at 38 mm 1 at 39 mm 12 at 40 mm 1 at 41 mm 5 at 42 mm 2 at 43 mm 3 at 44 mm 5 at 45 mm 2 at 46 mm 2 at 48 mm 1 at 50 mm
AUGUST				
14	Trawl	*Lucina floridana* Conrad Florida lucina	1	
		Libinia dubia H. Milne Edwards Spider crab	1	50 mm x 44 mm
		Callinectes danae (Smith) Gulf crab	1	27 mm x 47 mm

TABLE 7. (continued)

Sta-tions	Sampling Device	Species	Number of Specimens	Sizes
14 (continued)		*Pagurus pollicaris* Say Hermit crab In *Polinices duplicatus* (Say) shell covered with *Hydractinia*	1	
		Orthopristis chrysoptera (Linnaeus) Pigfish	1	1 at 120 mm
		Leiostomus xanthurus Lacépède Spot	2	1 at 118 mm 1 at 171 mm
		Citharichthys macrops Dresel Spotted whiff	2	1 at 85 mm 1 at 109 mm
		Prionotus tribulus Cuvier Bighead searobin	1	1 at 196 mm
FEBRUARY				
15	Trawl	*Myrophis* sp. Worm eel	1	40 mm
		Micropogon undulatus (Linnaeus) Atlantic croaker	5	1 at 35 mm 1 at 106 mm 1 at 109 mm 1 at 115 mm 1 at 120 mm

TABLE 7. (continued)

Sta-tions	Sampling Device	Species	Number of Specimens	Sizes
15 (continued)		*Lagodon rhomboides* (Linnaeus) Pinfish	9	1 at 83 mm 3 at 103 mm 1 at 105 mm 3 at 109 mm 1 at 135 mm
AUGUST				
15	Trawl	*Libinia dubia* H. Milne Edwards Spider crab	2	52 mm x 45 mm 72 mm x 65 mm
		Eurypanopeus depressus (Smith) Flat mud crab	2	11 mm x 12 mm 16 mm x 20 mm
		Clibanarius vittatus (Bosc) Striped hermit crab In *Thais* shell	3	1 at 40 mm 1 at 45 mm 1 at 62 mm
		Pagurus pollicaris Say Hermit crab In *Cantharus* shell	1	Small
		Palaemonetes pugio Holthuis Grass shrimp	5	1 at 13 mm 2 at 16 mm 1 at 21 mm 1 at 25 mm
		Hippocampus zosterae Jordan and Gilbert Dwarf seahorse	1	1 at 25 mm

TABLE 7. (continued)

Sta-tions	Sampling Device	Species	Number of Specimens	Sizes
15 (continued)		*Prionotus tribulus* Cuvier Bighead searobin	3	1 at 132 mm 1 at 146 mm 1 at 150 mm
		Opsanus beta (Goode and Bean) Gulf toadfish	1	1 at 190 mm
		Orthopristis chrysoptera (Linnaeus) Pigfish	3	2 at 116 mm 1 at 145 mm
		Leiostomus xanthurus Lacépède Spot	2	1 at 159 mm 1 at 161 mm
		Citharichthys macrops Dresel Spotted whiff	3	1 at 73 mm 1 at 79 mm 1 at 106 mm
AUGUST				
	Corpus Christi Bay Trawl	*Polinices duplicatus* (Say) Moon snail	2 shells	
		Crepidula convexa (Say) Slipper shell	1	
		Libinia dubia H. Milne Edwards Spider crab	1	12 mm x 10 mm
		Callinectes danae (Smith) Gulf crab	1	22 mm x 60 mm

TABLE 7. (continued)

Sta-tions	Sampling Device	Species	Number of Specimens	Sizes
Corpus Christi Bay Trawl (continued)				
		Pagurus pollicaris Say Hermit crab	1	1 at 30 mm
		Lolliguncula brevis (Blainville) Squid	1	1 at 45 mm
		Penaeus setiferus (Linnaeus) White shrimp	1	1 at 80 mm
		Trichiurus lepturus Linnaeus Atlantic cutlassfish	50 to 100	2 measured: 1 at 570 mm 1 at 622 mm
		Opsanus beta (Goode and Bean) Gulf toadfish	1	1 at 126 mm
		Citharichthys spilopterus Günther Bay whiff	1	1 at 95 mm
		Orthopristis chrysoptera (Linnaeus) Pigfish	2	1 at 98 mm 1 at 135 mm
		Arius felis (Linnaeus) Sea catfish	1	1 at 145 mm
		Cynoscion nothus (Holbrook) Silver seatrout	6	1 at 210 mm 5 at >210 mm
		Cynoscion arenarius Ginsburg Sand seatrout	2	1 at 125 mm 1 at 175 mm

TABLE 7. (continued)

Sta-tions	Sampling Device	Species	Number of Specimens	Sizes
Corpus Christi Bay Trawl (continued)				
		Micropogon undulatus (Linnaeus) Atlantic croaker	4	1 at 120 mm 1 at 133 mm 1 at 135 mm 1 at 175 mm
		Larval fish	2	1 at 28 mm 1 at 44 mm

TABLE 8. Plankton counts for three localities at Padre Isles

Station Number	Month 1973	Dominant Taxa	Organisms per Liter
8	January	Phytoplankton	4,892
		Coscinodiscus spp.	
		Lithodesmium spp.	
		Ceratium spp.	
		Biddulphia spp.	
			Total 4,892
8	September	Phytoplankton	14,081
		Ceratium sp.-1	
		Ceratium sp.-2	
		Peridinium	
		Merismopedia	
		Scenedesmus	
		Stephanopyxis	
		Biddulphia	
		Coscinodiscus	
		Oscillatoria	
		Schroederia	
		Asterionella	
		Zooplankton	9,936
		Calanoidae	
		Cyclopoidae	
		Balanus	
		Eulimella	
		Copepoda	
			Total 24,017
12	January	Phytoplankton	8,290
		Coscinodiscus spp.	
		Navicula spp.	
		Many filamentous forms	
			Total 8,290
12	September	Phytoplankton	1,699
		Merismopedia	
		Peridinium	
		Biddulphia	
		Ceratium sp.	

TABLE 8. (continued)

Station Number	Month 1973	Dominant Taxa	Organisms per Liter
		Phytoplankton (continued)	
		Schroederia	
		Navicula	
		Coscinodiscus	
		Zooplankton	2,517
		Calanoidae	
		Eulimella (larva)	
		Pelecypoda (larva)	
		Copepoda (nauplii larvae)	
		Cyclopoidae	
		Balanus (nauplii larvae)	
		Chaetognatha	
		Total	4,216
14	September	Phytoplankton	24,590
		Ceratium	
		Coscinodiscus	
		Asterionella	
		Merismopedia	
		Zooplankton	138,987
		Calanoidea	
		Eulimella (larva)	
		Cyclopoidae	
		Copepoda (nauplii larvae)	
		Balanus (nauplii larvae)	
		Pelecypoda (veliger larva)	
		Erythrops (Mysidacae)	
		Total	163,577

TABLE 9. Plankton counts for three localities at Padre Isles--1974

Station Number	Month 1974	Dominant Taxa	Organisms per Liter
8	February	Phytoplankton	59,000
		Coscinodiscus spp.	
		Peridinium	
		Ceratium spp.	
		Desmidiaceae	
		Unknown groups	
		Zooplankton	37,000
		Nauplii larvae	
		Rotifera	
		Copepoda	
		Eulimella	
		Calanoidea	
		Total	96,000
8	August	Phytoplankton	825,000
		Peridinium	
		Ceratium	
		Zooplankton	3,948,000
		Copepoda	
		Gastrapoda (*Eulimella* ?)	
		Trochophore larvae	
		Nauplii larvae	
		Bivalve larvae	
		Zooea larvae	
		Ciliata (*Favella*)	
		Crustacean larvae	
		Radiolaria	
		Total	4,773,000
12	February	Phytoplankton	131,000
		Fragillaria	
		Coscinodiscus	
		Peridinium	
		Ceratium	
		Desmideaceae	
		Pennales	
		Unknown groups	

TABLE 9. (continued)

Station Number	Month 1974	Dominant Taxa	Organisms per Liter
		Zooplankton	46,000
		Nauplii larvae	
		Rotifera	
		Copepoda (mixed)	
		Crustacean or copepod larvae	
		Calanoidea (copepods)	
		Total	177,000
12	August	Phytoplankton	533,000
		Ceratium (2 species)	
		Peridinium	
		Corethron (diatom)	
		Fragillaria (diatom)	
		Zooplankton	6,510,000
		Calanoidea	
		Nauplii larvae	
		Gastropoda (larvae)	
		Bivalve larvae	
		Amphipoda	
		Zooea larvae	
		Trochophore larvae	
		Radiolaria	
		Total	7,043,000
14	February	Phytoplankton	39,000
		Anacystis	
		Coscinodiscus	
		Peridinium	
		Ceratium	
		Desmidiaceae	
		Pennales	
		Unknown groups	
		Zooplankton	8,000
		Nauplii larvae	
		Copepoda (mixed)	
		Calanoidea	
		Total	47,000

TABLE 9. (continued)

Station Number	Month 1974	Dominant Taxa	Organisms per Liter
14	August	Phytoplankton	1,963,000
		Peridinium	
		Ceratium	
		Corethron (diatom)	
		Fragillaria (diatom)	
		Zooplankton	3,425,000
		Calanus	
		Gastropoda larvae	
		Trochophore larvae	
		Nauplii larvae	
		Bivalvia larvae	
		Ciliata (*Flavella*)	
		Crustacean larvae	
		Radiolaria (2 genera)	
		Chaetognatha	
			Total 5,388,000

TABLE 10. List of vascular plants collected from Padre Isles, August 19-23, 1974

Station Location*	Species	Abundance
A: Dunes at undeveloped northwest part of Padre Isles (undisturbed)	FAMILY: Convolvulaceae	
	Ipomoea Pes-caprae (L.) Goat-foot morning glory	Frequent
	Ipomoea stolonifera (Cyr.) Gmel. Beach morning glory	Occasional
	FAMILY: Onagraceae	
	Oenothera Drummondii Hook Beach evening primrose	Frequent
B: Marsh and sand flats, northwest part of development		
1. High marsh (undisturbed)	FAMILY: Crassulaceae	
	Sedum texanum J.G. Sm. Stonecrop	Occasional
	FAMILY: Compositae	
	Borrichia frutescens (L.) DC. Sea ox-eye daisy	Frequent
	Pluchea purpurascens (Sw.) DC. Canela, marsh-fleabane	Frequent
2. Marsh edge (undisturbed)	FAMILY: Compositae	
	Borrichia frutescens (L.) DC. Sea ox-eye daisy	Frequent
	FAMILY: Gramineae	
	Distichlis spicata (L.) Greene Saltgrass	Frequent

TABLE 10. (continued)

Station Location	Species	Abundance
C: Low coastal sands between dunes, west of golf course (undisturbed)	FAMILY: Amaranthaceae	
	Amaranthus greggii Wats. Pigweed	Frequent
	FAMILY: Compositae	
	Erigeron myrionactis Small Fleabane	Frequent
	Pluchea purpurascens (Sw.) DC. Marsh-fleabane	Frequent
	FAMILY: Cyperaceae	
	Cyperus polystachyos var. *texensis* (Torr.) Fern. Coastal sedge	Occasional
	FAMILY: Gramineae	
	Eragrostis oxylepis (Torr.) Torr. Red lovegrass	Occasional
	FAMILY: Juncaceae	
	Juncus scirpoides Lam. Rush	Frequent
	FAMILY: Leguminosae	
	Cassia fasciculata var. *Ferrisiae* (Britt.) B.L. Turner Patridge pea, prairie senna	Frequent

TABLE 10. (continued)

Station Location	Species	Abundance
	FAMILY: Onagraceae	
	Oenothera Drummondii Hook Beach evening primrose	Frequent
D: **Native** range, surrounding golf course fairways (influenced by irrigation)	FAMILY: Asclepiadaceae	
	Asclepias oenotheroides Cham. & Schlecht. Hierba de zizotes, milkweed	Occasional
	FAMILY: Compositae	
	Helianthus annuus L. Common sunflower	Occasional
	Helianthus argophyllus T.& G. Silverleaf sunflower	Occasional
	Liatris elegans (Walt.) Michx. Gay-feather, blazing-star	Occasional
	FAMILY: Cyperaceae	
	Cyperus polystachyos var. *texensis* (Torr.) Fern. Coastal sedge	Frequent
	Fimbristylis caroliniana (Lam.) Fern. Sedge	Occasional
	FAMILY: Gramineae	
	Schizachyrium scoparium var. *littoralis* (Nash) Gould Seacoast bluestem	Frequent

TABLE 10. (continued)

Station Location	Species	Abundance
	Eragrostis refracta (Muhl.) Scribn. Lovegrass	Frequent
	FAMILY: Euphorbiaceae	
	Euphorbia, sp. Spurge	Occasional
	FAMILY: Juncaceae	
	Juncus scirpoides Lam. Rush	Occasional
	FAMILY: Leguminosae	
	Crotalaria incana L. Chipilín, rattlepod	Occasional
	Galactia canescens Benth. Hoary milkpea	Occasional
	FAMILY: Onagraceae	
	Oenothera Drummondii Hook Beach evening primrose	Frequent
E_1: Reclaimed spoil on utility complex island	FAMILY: Compositae	
	Machaeranthera phyllocephala (DC.) Shinners Camphor daisy	Abundant
	Ambrosia sp. Ragweed	Frequent

TABLE 10. (continued)

Station Location	Species	Abundance
	FAMILY: Cyperaceae	
	Cyperus polystachyos var. *texensis* (Torr.) Fern. Coastal sedge	Frequent
	FAMILY: Gramineae	
	Eragrostis oxylepis (Torr.) Torr. Red lovegrass	Frequent
	FAMILY: Leguminosae	
	Cassia fasciculata var. *Ferrisiae* (Britt.) B.L. Turner Patridge pea, prairie senna	Frequent
	FAMILY: Onagraceae	
	Oenothera Drummondii Hook Beach evening primrose	Frequent
E_2: High stabilized (vegetation) dunes, south of utility complex road (undisturbed)	FAMILY: Compositae	
	Heterotheca pilosa (Nutt.) Shinners Golden aster, silk grass	Frequent
	Heterotheca subaxillaris (Lam.) Britt. & Rusby Camphor weed	Frequent
	FAMILY: Euphorbiaceae	
	Croton Pottsii (Kl.) Muell. Arg. Leather-weed	Frequent

TABLE 10. (continued)

Station Location	Species	Abundance
	FAMILY: Gramineae	
	Paspalum notatum Flügge Bahia grass	Abundant
	Uniola paniculata L. Sea oats	Frequent
	FAMILY: Leguminosae	
	Cassia fasciculata var. *Ferrisiae* (Britt.) B.L. Turner Patridge pea, prairie senna	Frequent
	Indigofera miniata var. *miniata* Ort. Scarlet pea	Occasional
F: Dense copse of mesquite-like bushes, low coastal sands, north of utility complex road at edge of reclaimed spoil area (slightly disturbed)	FAMILY: Compositae	
	Borrichia frutescens (L.) DC. Sea ox-eye daisy	Abundant
	Heterotheca pilosa (Nutt.) Shinners Golden aster, silk grass	Frequent
	Pluchea purpurascens (Sw.) DC. Canela, marsh-fleabane	Abundant
	FAMILY: Cyperaceae	
	Fimbristylis caroliniana (Lam.) Fern. Sedge	Occasional
	Fimbristylis sp. Sedge	Occasional

TABLE 10. (continued)

Station Location	Species	Abundance
	FAMILY: Leguminosae	
	Sesbania macrocarpa Muhl. Hemp sesbania, beguilla	Abundant
	Strophostyles helvola (L.) Ell. Amberique bean	Occasional
	FAMILY: Umbelliferae	
	Hydrocotyle umbellata L. Umbligo de Venus, water-pennywort	Frequent
G: **Oak** grove on stabilized high dunes, corner of Galleon Bay (undisturbed)	FAMILY: Fagaceae *Quercus virginiana* Mill. Live oak	Abundant
	FAMILY: Lauraceae	
	Persea Borbonia (L.) Spreng. Red bay	Occasional
	FAMILY: Leguminosae	
	Crotalaria incana L. Chipilin, rattlepod	Frequent
	FAMILY: Rutaceae	
	Zanthoxylum Fagata (L.) Sarg. Colima, Una de Gato, Tickletongue	Frequent

TABLE 10. (continued)

Station Location	Species	Abundance
H: Low coastal sand flats, near Tamarisk grove, east of Padre Island Drive (slightly disturbed)	FAMILY: Amaranthaceae	
	Tidestromia lanuginosa var. *lanuginosa* (Nutt.) Standl. Esparita vaqueros	Occasional
	FAMILY: Compositae	
	Borrichia frutescens (L.) DC. Sea ox-eye daisy	Frequent
	Gaillardia pulchella Foug. Indian blanket, firewheel	Occasional
	Machaeranthera phyllocephala (DC.) Shinners Camphor daisy	Frequent
	FAMILY: Gentianaceae	
	Eustoma exaltum (L.) G. Don. Catchfly-gentian	Occasional
	FAMILY: Gramineae	
	Eragrostis oxylepis (Torr.) Torr. Red lovegrass	Frequent
	FAMILY: Plumbaginaceae	
	Limonium Nashii Small. Sea-lavender, marsh-rosemary, statice	Occasional
	FAMILY: Primulaceae	
	Samolus alyssoides Heller Water pimpernel, brookweed	Occasional

TABLE 10. (continued)

Station Location	Species	Abundance
	FAMILY: Tamaricaceae	
	Tamarix sp. Tamarisk, salt cedar	Occasional

*Station locations shown on Figure 1 (page 3)

DESCRIPTION OF PLANT COVER AT SELECTED LOCALITIES--PADRE ISLES*

Area 1. From Gulf beach, north end of development west to Packery Channel arm in front of Gulfstream

a) Beach area. Clumps of two types of dune grass, including some sea oats and a small headed oat-like grass. Clumps create small hummocks. A few rodent holes, otherwise relatively lifeless.

b) Base of high dunes, 200 yards from water's edge. Mostly cord grass or saw grasses (hard and thin blades). Few animal signs on beach slope. Vines dead.

c) Top of high dunes and higher interdune area. Edge of yellow compositae community and yellow mallow-like green, broad-leaf. Some sea oats and many dead forbs (Dr. Oppenheimer says dune vegetation is killed by freezes). Cord grass common--red-winged blackbirds, kangaroo rats, coyotes, large gopher mounds, and high rodent activity. Vines dead.

d) North of dunes on flats to edge of Packery Channel. Short cord grass and low compositae. Cover 8" to 16" high. Some sandhill cranes on channel edge.

e) Higher flats between first high dunes and second row of high dunes. Interface between Packery flat and higher interdune flats covered with a tall feathery grass. Predominant plant on flat is dead, woody mahogany colored species, a few dead leaves. Low green broad-leaf composite and yellow mallow form mats in back of feather-grass row. Many gopher signs and seaside sparrow (?).

f) Second row of dunes. Tops and sides covered with the gree-leaved composite. Some *Opuntia* (prickly pear) cactus.

g) Area between Gulfstream (south) and new construction (Portofine) had been leveled and denuded. Vegetation covering small sand hummocks is same as that growing on undisturbed hummocks on north side.

h) Area between second road from beach to small canal perpendicular to road. Dense high and low cord grass (*Spartina*). Some low green compositae with yellow flowers, algae cover grass leaves in water. Saw two rice rats (small) dive into water at canal's edge.

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*Observations made during first field trip, January 1973

Area 2. South of last apartments at south edge of development on Gulf side to county park road.

a) Stands of cane in back of hummocky area. Sand flats of old channel with thin cover of short grass. Cane is in back of snow fence. Hummocks have same vegetation as Area 1(a).

b) High dunes covered with small yellow mallow (blooming) and dead shrubby vegetation and grass. Flock of longspurs (?), several meadowlarks--rabbit tracks, but no other rodent signs.

c) Marshy ponds between large dunes and Padre Island Drive. Contained 4 mallards, 6 black ducks, 2 coots, 1 willet, and several sanderlings. Edge of ponds with Bermuda grass, fiddler crab holes, low succulent aquatic vegetation. Rice rat runs.

d) Between high dunes and marshy ponds typical high grass no seed stalks. Many gopher mounds on northwest side.

e) Low ridges between Packery Channel area and Padre Island Drive, bounded by County Park Road (Gulf beach). Shallow grassy ponds, grass (*Spartina* and Bermuda) on lows and green, yellow-flowered composite on higher hummocks with some tall grass. Ponds coated with algal mat, but no invertebrates.

Western Isles Motel has small package sewer plant which puts effluent out onto lower ground. Strong sewer smell in ponds south of outfall.

Area 3. North of road to Inn, to edge of Packery Channel and Mustang Island State Highway.

a) Rows of salt cedar--planted as wind breaks, but nearly dead and brown. Sewage effluent evident in ponded areas. Vegetation same as on south side of Inn Road. Observed birds--snowy egret (white phase of reddish egret?), golden-shafted flicker, herring gulls, black duck. Marshy on east side of road.

b) Packery Channel near highway bridge. Birds--cormorants, reddish egrets, American egret, royal terns, laughing gulls, willets.

Area 4. Developed canal and demonstration house region

a) Edge of canal under first bridge. Flocks of white pelican, pintails, cormorants, laughing gulls. Dredged spoil terrace (no houses), covered with Bermuda grass (dead), few dead forbs and blooming malvaceae and compositae, large jack rabbit. Cover nearly as dense as undisturbed island.

b) Entrance to developed canal on east side (near sewage plant). Two to 10 acres of very high dunes, 15-feet covered with a miniature live oak, woody evergreen shrub (2 types of broad leaves--citrus?) *Opuntia* (pickly pear). Oaks about 5 to 6 feet high, some with acorns. Live jack rabbits.

Area 5. Utility road from Padre Island Drive to water area

a) Grass flats, small ponds, high dunes covered with the two yellow flowers found throughout. A little grass and dead mahogany-like shrub. Tall cane-like annuals, dead. Mud flats extensive but bare. Rodents trapped for two nights, fairly abundant. Spotted sandpiper.

Area 6. Large shifting dunes moving from Laguna to Gulf on back side of island, nearly devoid of vegetation except yellow malva. At base of dunes, round-leaved plant, creepy and still green. Concentration of sandhill cranes.

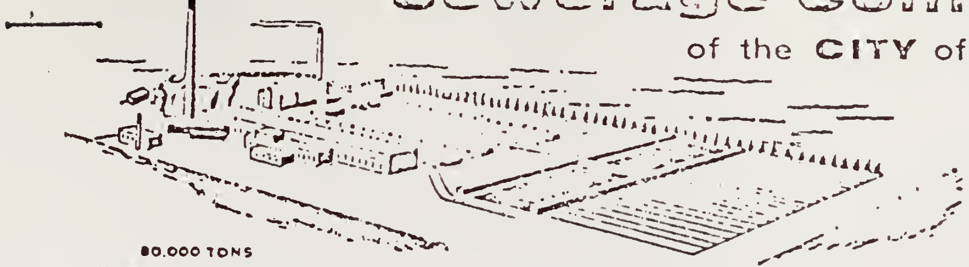
Birds sighted on Thursday--marsh hawks, American and reddish egrets, herring and laughing gulls, mockingbird, doves, quail, meadowlarks, English sparrows, willets, sanderlings.

TABLE 11. Coliform bacterial counts on bottom water samples

Station Number	Coliform Counts--cells/100 ml 1973 Jan.	 Sept.	 1974 Feb.	 Aug.
1	10,500	720	110	510
2	928	520	50	1,675
3	2,000	790	40	530
4	9,200	no sample	no sample	1,090 (new station)
5	6	0	0	90
6	1,200	no sample	4	no sample
7	2,700	1,590	270	750
8	382	1,650	40	1,530
9	88	222	11	670
10	196	31	1	1,050
11	138	139	25	400
12	28	221	8	20
13	134	5	37	160
14	12	7	5	0
15	0	1	0	0

APPENDIX II

SOIL REPORTS



of the CITY of MILWAUKEE

OFFICES AT SEWAGE DISPOSAL PLANT, JONES ISLAND • PHONE 271-2403
P. O. BOX 2079 • MILWAUKEE, WISCONSIN 53201

March 22, 1971

Mr. Craig Smalley
10877 Padre Island Drive
Corpus Christi, Texas 78418

Dear Mr. Smalley:

Enclosed is the soil analysis report on the samples received from you February 17, 1971. The results are explained on the back of the analysis sheet.

There is a great deal of variation among the samples, so in order to achieve any degree of uniformity some rather complex applications will be necessary. I am taking the liberty to send a copy of this report to Mr. Al Crain at Goldthwaite's of Houston, soliciting any comment he may wish to make on the report or recommendations.

Basically most samples are low in phosphate, potash, calcium and magnesium. P and K improvement is easy. The big problem is increasing calcium and magnesium levels, because the already high pH makes the heavy use of dolomitic limestone rather hazardous in sand. Too much lime added to soils with appreciable sodium content can raise the pH excessively.

Because of the extreme variability of these soils, quite common in new construction, upgrading fertility should be done with caution. Test strip applications should be considered in some instances.

Greens: The front 9 is quite different from the back 9 with regard to all nutrients as well as sodium. We suggest the front 9 greens receive 2 applications of gypsum at 50 lbs. per 1,000 sq. ft. each. These should be spaced 3 to 4 weeks apart. On the back 9, only 11, 17 and 18 require one application at this time at the same rate. This will improve the calcium levels.

COMMISSIONERS: DONALD E. MURPHY, CHAIRMAN • CHARLES E. GILLETT, VICE CHAIRMAN
DONALD La PREST • THEODORE ASTI • RICHARD J. STEINBERG

RAY D. LEARY
Chief Engineer and
General Manager

To reach the desired magnesium level in these soils, repeated application of fertilizer grade Epsom salt should be made at a rate of 5 lbs. per 1,000 sq. ft. per application. This material contains only 17 - 18% Mg, so this may require fairly frequent applications.

Perhaps a better approach to supplying magnesium on greens, tees, and more importantly, the fairways is to locate a supply of magnesia. This is sold under the trade names Magox and Gran Mag. They also have an effect on soil pH, so a thorough study should be made of the materials from the manufacturer's technical data sheets or agronomists.

The front 9 greens should receive 2 applications of 0-20-20 or 5-20-20 at 10 lbs. per 1,000 sq. ft. each. These should be spaced 2 to 3 weeks apart. The back nine requires one application at 5 lbs. per 1,000 sq. ft. overall and an additional 10 lbs. per 1,000 sq. ft. to numbers 17 and 18.

Tees: All tees should be treated like the front 9 greens, except that only 1 application of gypsum is needed. You may wish to skip this application on 11TS, 16LT and 18. One or more applications of Epsom salt should be made to all tees. two applications of 5-20-20 or 10-20-20 at 10 lbs. per 1,000 sq. ft. each are required in all cases, even though potash may be adequate at this time. You may wish to use double rates of 0-10-10 or 5-10-10.

Fairways: Because of existing pH levels we hesitate to recommend dolomitic limestone in these areas to supply calcium and magnesium. Both nutrients are badly needed. To achieve a desired level of calcium, over 6 tons of gypsum per acre is needed. This can be done gradually, starting with an application of 2 ton per acre this spring and the remainder in 1-ton applications over the coming year or so. If you can obtain Magox or Gran Mag, (50% Mg) about 1400 lbs. per acre will suffice. It would be a good idea to apply at least 200 lbs. of Epsom salt first, to assure a temporary emergency supply of this nutrient.

To supply adequate P and K, apply 500 lbs. of 10-20-20 or 1,000 lbs. of 5-10-10 per acre.

Unidentified Samples: By and large these areas should be treated like the fairways, except that 75 and ShA do not require gypsum or magnesia at this time. Epsom salt may show response, however. Samples 82 and Club S need liming-50 lbs. of dolomitic limestone per 1,000 sq. ft. in addition to gypsum and magnesia.

Special Note: In quantities used and the materials to be applied, gypsum is the only material that will not require irrigation immediately after application.

Nitrogen Requirements: Greens and tees should require at least 2 pounds actual N per month. This should be supplied as a natural organic such as Milorganite for the basic source. You will get best response from ammonium sulfate as the source of soluble N. Tests on sands in Florida have shown this material better than either ammonium nitrate or urea.

Saline areas: Number 1 green and fairway are moderately and strongly saline, respectively. The gypsum treatment will help, provided adequate drainage is available to leach the salt out of the root zone. Without drainage, the situation can only get worse. If rapid greenup is needed in case of chlorosis in these or other areas, use ferrous sulfate at 2 oz. per 1,000 sq. ft. in 5 gallons of water, as a leaf feeding.

Milorganite performs very well in saline or alkaline soils. The minor element content is naturally chelated to resist tie-up in the soil. On fairways after immediate N, P, & K requirements are supplied, a good program is to alternate Milorganite at 800 lbs. per acre and ammonium sulfate at 200 lbs. per acre. At least 2 applications per year of each is required until a good sole of turf is established, at which time the sulfate applications can be reduced.

We regret the necessity of such a long report, but these sands require it. Because of this, could you please fill us in on planting fertilization, the grasses used and some soil information:

1. Is number 1 a very low area, a filled area or another reason for high sulfates in the green and high chlorides on the fairway?
2. What was the general preplant fertilizer and rate recommended for it.
3. How much liming was done. (see previous analysis and report).
4. What are areas designated U, GB, etc? This information may come in handy in later tests.
5. Why are samples 75 and ShA so well supplied with calcium and magnesium, but not other nutrients?

We will also appreciate any other information you can give us to add to an already interesting file. If we can be of additional service please feel free to call on us.

Sincerely,

Jim Latham

James M. Latham, Jr.
Chief Field Agronomist
Turf Service Bureau

JML/bmr
Enclosures (2)
cc: Goldthwaite's of Houston
" of San Antonio

Soil Analysis

Turf Service Bureau, Sewerage Commission, Milwaukee, Wis.

MILORGANITE

from: Padre Isles Golf Course

omitted by: Craig Smalley - 10877 Padre Island Drive - Corpus Christi, Texas 78418

Nos. 601-644 Date Received 2-17-71 Date Reported 3-19-71

Area Sampled	No.	pH	0.3 Normal Hydrochloric Acid Extract Available in lbs. per acre PHOSPHORUS (P)	POTASH (K_2O)	CALCIUM (Ca)	MAGNESIUM (Mg)	SODIUM (Na)	Water Extract SOLUBLE SULFATES	CHLORIDES
ENS									
E.c. 5.75	1	7.10	25	185	1800	300	370	6000	TR
	2	7.15	50	260	1900	320	450		
	3	7.40	40	185	1500	300	430		
	9	7.10	30	200	1850	320	480		
E.c. 1.55	10	7.30	115	400	8200	750	1000	TR	3000
	11	7.20	160	300	3200	400	590		
	16	7.40	185	450	5300	575	830		
	17	7.60	70	300	2550	500	640		
E.c. 2.89	18	7.35	55	320	3600	550	770	TR	6000
GRAY BROWN FINE SAND.									
TEES E.c. 2.30	1LT	7.60	35	245	3900	450	630	TR	4500
	3	7.75	55	200	3700	370	390		
	3LT	7.70	45	225	4150	420	570		
E.c. 1.93	9	7.60	35	190	3350	400	480	TR	3000
	9LT	7.70	35	160	2450	370	410		
	10	7.60	35	245	4600	475	650		
	11TS	7.40	90	340	5350	550	660		
E.c. 2.07	16	7.60	30	210	2350	325	530	TR	4000
	16LT	7.55	50	285	5300	550	680		
	17	7.70	35	190	3350	300	510		
	18	7.70	45	285	7600	500	830		
GRAY BROWN FINE SAND									
FAIRWAYS-E.c. 8.28	1	6.75	90	200	600	150	2300	TR	10000
	2	6.40	65	215	400	50	910		
E.c. 1.38	3	7.10	35	85	400	25	270	TR	3000
	9	6.45	15	110	300	TR	530		
	10	6.70	15	90	300	TR	300		
	11	7.40	25	85	400	TR	250		
E.c. 1.04	16	7.55	65	85	650	150	240	TR	2000
	17	7.00	30	155	300	TR	510		
	18FN	7.25	35	160	700	90	590		
	18FS	7.45	15	85	250	25	210		
("U") Undisturbed GC									
	1	6.60	TR	60	600	25	220		
E.c. 2.30	3	6.25	TR	90	200	TR	560	TR	6000
	10	6.40	TR	60	700	30	150		
GRAY FINE SAND.									

See reverse side for explanation of these results.

Asst. Director of Laboratory

ver)

Turf Service Bureau, Sewerage Commission, Milwaukee, Wis.

MILORGANITE

les from: Padre Isles Golf Course

Submitted by: Craig Smalley - 10877 Padre Island Drive - Corpus Christi, Texas 78418

PAGE 2

Nos. 601-644 Date Received 2-17-71 Date Reported 3-19-71

Area Sampled	No.	pH	0.3 Normal Hydrochloric Acid Extract Available in lbs. per acre					Water Extract	
			PHOSPHORUS (P)	POTASH (K_2O)	CALCIUM (Ca)	MAGNESIUM (Mg)	SODIUM (Na)	SOLUBLE SULFATES	SOLUBLE CHLORIDES
(G.B.) Galleon Bay	74	7.90	45	80	200	TR	130		
E.c. 0.48	75	8.20	30	80	13800	600	240	TR	TR
	79	8.00	45	90	5200	175	130		
	82	5.80	10	60	TR	TR	TR		
Miscellaneous Dairy Queen	DQ	7.60	15	75	2700	30	80		
Seok E.c. 0.39	ShA	8.00	35	35	10300	550	150	TR	TR
	MCay	7.75	TR	10	1150	30	50		
	27	7.50	10	90	1050	75	410		
E.c. 2.14	DR	6.90	30	85	300	15	480	TR	5000
Club	N	7.70	5	60	400	TR	210		
E.c. 0.54 - Club	S	5.90	5	35	500	TR	100	TR	500
Gray fine sand.									

See reverse side for explanation of these results.

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Asst. Director of Laboratory

Soil Analysis

Turf Service Bureau, Sewerage Commission, Milwaukee, Wis.

amples from: Padre Isles Country Club - Box 8809 - Corpus Christi, Texas 78412

Submitted by: David Gregg, Golf Course Superintendent

ab. Nos. 576-535 Date Received 2-7-72 Date Reported 3-13-72

Area Sampled	No.	pH	0.3 Normal Hydrochloric Acid Extract Available in lbs. per acre					Water Extract	
			PHOSPHORUS (P)	POTASH (K_2O)	CALCIUM (Ca)	MAGNESIUM (Mg)	SODIUM (Na)	SOLUBLE SULFATES	CHLORIDE
GREENS	1	5.50	155	100	750	1040	350	TR	3000
	2	5.80	245	150	950	730			
	9	5.80	335	285	1200	1040			
	11	6.40	375	270	2300	1320	650	Tr	1500
	16	6.80	575	235	4150	1200			
	18	5.80	265	175	1050	940			
FAIRWAYS	1	5.90	115	60	850	300			
TEE	1	7.10	115	85	2100	260	280	TR	2000
FAIRWAY & TEE	11	6.70	125	60	750	230			
" "	18	6.90	115	85	750	460	390	Tr	3000

Light brown fine sand.

See reverse side for explanation of these results.

Over)

L. A. Ernst

HOW TO EVALUATE SOIL TEST FIGURES

Nitrogen is never determined because existing methods are not satisfactory for grassland areas. Need for nitrogen can be judged by the behavior of the grass. Poor color, slow rate of growth, thin turf, and the presence of weeds and clover are the usual signs.

Soil reaction is reported in terms of pH. A neutral soil is pH 7.0. Lower figures denote increasing acidity, and higher ones increasing alkalinity. Need for lime is indicated when soil reaction is below pH 6.0. For details about lime usage on turf grass see our Bulletin No. 1.

Content of plant food elements is reported as pounds per acre. The figures for calcium and magnesium are not very significant unless lime is needed. Calcium should approach 3,000 to 5,000 pounds or more per acre, and magnesium should exceed 700 pounds per acre. Whenever it is less than 700 pounds per acre there is the possibility of a soil deficiency in magnesium. The use of a dolomitic type limestone to correct acidity eliminates magnesium as a soil deficiency. The dolomite should contain 20% or more of magnesium reported as the oxide.

Phosphorus and potash should be higher in greens than fairways or lawns because clippings are removed and growth is maintained by constant waterings. The minimum quantities needed by grass are as follows:

	Pounds per Acre	
	Phosphorus	Potash
Fairways and lawns	75 - 100	150 - 200
Golf Course Greens	200 - 300	300 - 400

High phosphorus, especially when associated with a high pH, that is, above pH 7.0 is likely to induce iron chlorosis. Iron phosphate is very insoluble. A high pH tends to immobilize other forms of iron.

Sometimes soluble salts are determined. The principal ones in the soil are chlorides, sulphates, and, on alkaline soils, carbonates. Whenever they are high plants cannot absorb water. Then trouble results, especially during warm weather when evaporation is at a high rate. The amount of chlorides and sulphates is reported as pounds per acre. When they exceed several thousand pounds, trouble may occur.

YOUR SUGGESTED FERTILIZATION MEANS:

Total plant nutrients per acre		
Lb. N	Lb. P_2O_5	Lb. K_2O

To convert these values to a specific grade of mixed fertilizer or a material, use this formula:

$$\text{lb. of fertilizer needed} = \frac{\text{lb./A of nutrient desired}}{\text{\% nutrient in fertilizer}} \times 100$$

Example 1:

Lb. N	Lb. P_2O_5	Lb. K_2O
60	0	0

Fertilizer available, ammonium nitrate (34-0-0)

$$\text{lb. of ammonium nitrate needed/A} = \frac{60}{34} \times 100 = 176$$

Example 2:

Lb. N	Lb. P_2O_5	Lb. K_2O
120	60	60

Fertilizer available, 12-12-12 and anhydrous ammonia (82-0-0)

$$\text{lb. 12-12-12 needed/A} = \frac{60\ (N, P_2O_5, K_2O)}{12} \times 100 = 500 \text{ lb.}$$

500 lb. 12-12-12 will supply 60-60-60

$$\text{Lbs. anhydrous ammonia needed to supply remaining 60 lb. of N/A} = \frac{60}{82} \times 100 = 73 \text{ lb.}$$

LIME REQUIREMENT (TONS OF GROUND LIMESTONE PER ACRE)

The lime requirement is generally defined as the amount of liming material needed to establish and maintain the soil pH within the desired range for 3 to 5 years. To be most effective in neutralizing soil acidity and bringing the pH into the desirable range, liming materials should be applied at a time when mixing with the soil can be accomplished.

Liming permanent sods requires applying on the surface. Such applications are satisfactory for maintenance purposes.

For a liming material to be effective, it must be spread uniformly. Since liming practices have long-range benefits, they can be carried out at any period of the year when conditions are favorable.

TEXAS A&M UNIVERSITY—AGRICULTURAL EXTENSION SERVICE

SOIL TEST REPORT

ASCS Farm No.

Name Padre Isles Country Club Address County

SOIL TEST RESULTS AND CLASSIFICATION

Lab. no.	Sender's sample no.	Soil reaction (pH)	Calcium Ca		Magnesium Mg		Predicted nitrogen level	Phosphorus P_2O_5		Potassium K_2O		Salinity hazard	Zinc	Iron	Manganese	% Organic Matter	Levels
			# / A*	level	# / A*	level		# / A*	level	# / A*	level						
49145	17F	7.1	1120	M	340	H	L	456	VH	190	L	Slight				0.4	VL = Very Low L = Low M = Medium H = High VH = Very High > Means "More Than"
46	18F	6.0	1180	M	208	M	L	335	VH	280	M	Slight				0.2	

*The values for pounds per acre is based on testing procedures used at Texas A&M soil testing laboratories and may differ from results obtained by other procedures. The level of very low, low, etc., is more important than pounds per acre, since these levels indicate the probability of response to added plant nutrients.

SUGGESTED FERTILIZATION AND LIMING RATES

(Please read back side of report and the enclosed leaflet.)

Sample no.	Crop	Limestone	Total plant nutrients per acre			When to apply	REMARKS
		tons/A	lb. N	lb. P_2O_5	lb. K_2O		

If you have questions about this soil test report, see Mr. , your county agricultural agent,

who is located in

[illegible] Date samples received Date completed

AII-10

SOIL TESTIN LABORATORY
TEXAS A&M UNIVERSITY—AGRICULTURAL EXTENSION SERVICE

SOIL TEST REPORT

ASCS Farm No.

Name Padre Isles Country Club Address County

SOIL TEST RESULTS AND CLASSIFICATION

Lab. no.	Sender's sample no.	Soil reaction (pH)	Calcium Ca		Magnesium Mg		Predicted nitrogen level	Phosphorus P_2O_5		Potassium K_2O		Salinity hazard	Zinc	Iron	Manganese	% Organic Matter
			# / A*	level	# / A*	level		# / A*	level	# / A*	level					
49141	9F	6.1	1180	M	308	H	L	261	VH	300	M	Slight				0.4
42	10F	6.0	880	M	218	M	L	153	H	270	M	Slight				0.1
43	11F	6.0	620	M	180	M	L	132	H	200	L	Slight				0.1
44	16F	6.3	620	M	224	M	L	160	H	190	L	None				0.2

Levels
VL = Very Low
L = Low
M = Medium
H = High
VH = Very High

> Means "More Than"

*The values for pounds per acre is based on testing procedures used at Texas A&M soil testing laboratories and may differ from results obtained by other procedures. The level of very low, low, etc., is more important than pounds per acre, since these levels indicate the probability of response to added plant nutrients.

SUGGESTED FERTILIZATION AND LIMING RATES

(Please read back side of report and the enclosed leaflet.)

Sample no.	Crop	Limestone	Total plant nutrients per acre			When to apply	REMARKS
		tons/A	lb. N	lb. P_2O_5	lb. K_2O		

If you have questions about this soil test report, see Mr. , your county agricultural agent

OIL TESTING LABORATORY

TEXAS A&M UNIVERSITY—AGRICULTURAL EXTENSION SERVICE

SOIL TEST REPORT

Name Padre Isles Country Club Address ASCS Farm No.

County

SOIL TEST RESULTS AND CLASSIFICATION

Lab. no.	Sender's sample no.	Soil reaction (pH)	Calcium Ca		Magnesium Mg		Predicted nitrogen level	Phosphorus P_2O_5		Potassium K_2O		Salinity hazard	Zinc	Iron	Manganese	% Organic Matter
			# / A*	level	# / A*	level		# / A*	level	# / A*	level					
49137	18T	5.9	1660	H	> 500	H	L	305	VH	580	H	Slight				1.0
38	1F	6.0	880	M	236	M	L	125	H	190	L	Slight				0.1
39	2F	6.9	1000	M	288	H	L	218	VH	190	L	Slight				0.3
40	3F	7.0	1000	M	276	H	L	148	H	160	L	None				0.3

*The values for pounds per acre is based on testing procedures used at Texas A&M soil testing laboratories and may differ from results obtained by other p
The level of very low, low, etc., is more important than pounds per acre, since these levels indicate the probability of response to added plant nutrients.

SUGGESTED FERTILIZATION AND LIMING RATES

(Please read back side of report and the enclosed leaflet.)

Sample no.	Crop	Limestone	Total plant nutrients per acre			When to apply	REMARKS
		tons/A	lb. N	lb. P_2O_5	lb. K_2O		

If you have questions about this soil test report, see Mr.

who is located in , your county

SOIL TESTING ORATORY

TEXAS A&M UNIVERSITY—AGRICULTURAL EXTENSION SERVICE

SOIL TEST REPORT

ASCS Farm No.

Name Padre Isles Country Club Address County

SOIL TEST RESULTS AND CLASSIFICATION

Lab. no.	Sender's sample no.	Soil reaction (pH)	Calcium Ca		Magnesium Mg		Predicted nitrogen level	Phosphorus P_2O_5		Potassium K_2O		Salinity hazard	Zinc	Iron	Manganese	% Organic Matter
			# / A*	level	# / A*	level		# / A*	level	# / A*	level					
49133	10T	7.5	>6000	VH	>500	H	L	>550	VH	840	VH	Slight				0.8
34	11T	6.0	2460	H	>500	H	L	509	VH	690	VH	Medium				1.1
35	16T	6.5	1760	H	>500	H	L	378	VH	550	H	Slight				1.0
36	17T	6.2	1460	H	486	H	L	143	H	360	H	Slight				0.6

Levels
VL = Very Low
L = Low
M = Medium
H = High
VH = Very High

> Means "More Than"

*The values for pounds per acre is based on testing procedures used at Texas A&M soil testing laboratories and may differ from results obtained by other procedures. The level of very low, low, etc., is more important than pounds per acre, since these levels indicate the probability of response to added plant nutrients.

AII-13

SUGGESTED FERTILIZATION AND LIMING RATES

(Please read back side of report and the enclosed leaflet.)

Sample no.	Crop	Limestone	Total plant nutrients per acre			When to apply	REMARKS
		tons/A	lb. N	lb. P_2O_5	lb. K_2O		

f you have questions about this soil test report, see Mr. , your county agricultural agent.
vho is located in

D-514C

SOIL TESTING LABORATORY

TEXAS A&M UNIVERSITY—AGRICULTURAL EXTENSION SERVICE

SOIL TEST REPORT

ASCS Farm No.

Name Padre Isles Country Club Address P.O. Box 8809 - Corpus Christi 78412 County Nueces

SOIL TEST RESULTS AND CLASSIFICATION

Lab. no.	Sender's sample no.	Soil reaction (pH)	Calcium Ca		Magnesium Mg		Predicted nitrogen level	Phosphorus P_2O_5		Potassium K_2O		Salinity hazard	Zinc	Iron	Manganese	% Organic Matter
			# / A*	level	# / A*	level		# / A*	level	# / A*	level					
49129	1T	6.7	1660	H	346	H	L	326	VH	280	M	None				0:5
30	2T	7.5	3740	H	>500	H	L	255	VH	600	H	Medium				1.1
31	3T	7.3	2420	H	>500	H	L	456	VH	450	H	Slight				0.8
32	9T	6.6	2840	H	>500	H	L	486	VH	720	VH	Slight				0.8

Levels
VL = Very Low
L = Low
M = Medium
H = High
VH = Very High
> Means "More Than"

*The values for pounds per acre is based on testing procedures used at Texas A&M soil testing laboratories and may differ from results obtained by other procedures. The level of very low, low, etc., is more important than pounds per acre, since these levels indicate the probability of response to added plant nutrients.

AII-14

SUGGESTED FERTILIZATION AND LIMING RATES

(Please read back side of report and the enclosed leaflet.)

Sample no.	Crop	Limestone tons/A	Total plant nutrients per acre lb. N	lb. P_2O_5	lb. K_2O	When to apply
All samples	Grass			See remarks		

REMARKS

The pH of samples from tees and fairways is generally higher than for greens, the soluble salt levels generally lower and the potassium levels lower. Using nitrogen as suggested in B-1129 plus about 3 lbs of muriate ofpotash per 1000 sq. ft. should be adequate for tees. For fairways about 200 lbs of ammonium nitrate per acre now(if nothing has been applied) and again in the late summer plus about 150 lbs of muriate of potash per acre of potash per acre for those soils low in potassium should be adequate. You will want to examine your source of material for building new greens so as not to get sand high in salt. This may have been the origin of salt in your present greens.

If you have questions about this soil test report, see Mr. Melvin L. Wilson, your county agricultural agent,

TEXAS A&M UNIVERSITY—AGRICULTURAL EXTENSION SERVICE

SOIL TEST REPORT

ASCS Farm No.

Name Padre Island Investment Corp. Address P.O. Box 8809 - Corpus Christi 78412 County Nueces

SOIL TEST RESULTS AND CLASSIFICATION

Lab. no.	Sender's sample no.	Soil reaction (pH)	Calcium Ca		Magnesium Mg		Predicted nitrogen level	Phosphorus P_2O_5		Potassium K_2O		Salinity hazard	Zinc	Iron	Manganese	% Organic Matter
			# / A*	level	# / A*	level		# / A*	level	# / A*	level					
ST7929		7.5	940	M	182.0	M	VL	16	VL	90	VL	None	H	H	L	0.1

Levels
VL = Very Low
L = Low
M = Medium
H = High
VH = Very High

> Means "More Than"

*The values for pounds per acre is based on testing procedures used at Texas A&M soil testing laboratories and may differ from results obtained by other procedures. The level of very low, low, etc., is more important than pounds per acre, since these levels indicate the probability of response to added plant nutrients.

SUGGESTED FERTILIZATION AND LIMING RATES

(Please read back side of report and the enclosed leaflet.)

Sample no.	Crop	Limestone	Total plant nutrients per acre			When to apply	REMARKS
		tons/A	lb. N	lb. P_2O_5	lb. K_2O		
	Grass	0	130	100	100		We assume that you will be planting bermuda grass on fairways and note a very low fertility level. You may want to apply 50-100-100 (500 lbs of a 10-20-20 or equivalent per acre) at or before seeding then topdress 80 lbs of nitrogen per acre after the grass is well established.

If you have questions about this soil test report, see Mr. Melvin Wilson, your county agricultural agent.

who is located in Robstown

4/27/73 5/3/73

TEXAS A&M UNIVERSITY—AG...CULTURAL EXTENSION SERVIC.

SOIL TEST REPORT

ASCS Farm No.

..ame Padre Isles Country Club Address County

SOIL TEST RESULTS AND CLASSIFICATION

Lab. no.	Sender's sample no.	Soil reaction (pH)	Calcium Ca		Magnesium Mg		Predicted nitrogen level	Phosphorus P_2O_5		Potassium K_2O		Salinity hazard	Zinc	Iron	Manganese	Copper
			# / A*	level	# / A*	level		# / A*	level	# / A*	level					
ST7912	10G	5.5	2760	H	>500	H	L	456	VH	800	VH	Medium	H	H	H	H
13	11G	5.4	2360	H	>500	H	L	446	VH	690	VH	Medium	H	H	H	H
14	16G	5.5	4560	VH	>500	H	L	446	VH	820	VH	Medium	H	H	H	H
15	17G	5.6	3880	H	>500	H	L	456	VH	570	H	Medium	H	H	H	H

Levels
VL = Very Low
L = Low
M = Medium
H = High
VH = Very High

> Means "More Than"

*The values for pounds per acre is based on testing procedures used at Texas A&M soil testing laboratories and may differ from results obtained by other procedures. The level of very low, low, etc., is more important than pounds per acre, since these levels indicate the probability of response to added plant nutrients.

AII-16

SUGGESTED FERTILIZATION AND LIMING RATES

(Please read back side of report and the enclosed leaflet.)

Sample no.	Crop	Limestone	Total plant nutrients per acre			When to apply	REMARKS
		tons/A	lb. N	lb. P_2O_5	lb. K_2O		

If you have questions about this soil test report, see Mr. , your county agricultural agent

who is located in

Date samples received Date completed

TEXAS A&M UNIVERSITY—AGRICULTURAL EXTENSION SERVICE

SOIL TEST REPORT

ASCS Farm No.

Name Padre Isles Country Club Address Box 8809 - Corpus Christi 78412 County Nueces

(Greens)

SOIL TEST RESULTS AND CLASSIFICATION

Lab. no.	Sender's sample no.	Soil reaction (pH)	Calcium Ca		Magnesium Mg		Predicted nitrogen level	Phosphorus P_2O_5		Potassium K_2O		Salinity hazard	Zinc	Iron	Manganese	Copper
			# / A*	level	# / A*	level		# / A*	level	# / A*	level					
ST7908	1G	6.3	3800	H	>500	H	L	522	VH	690	VH	Medium	H	H	H	H
09	2G	5.6	1940	H	>500	H	L	417	VH	660	VH	Medium	H	H	H	H
10	3G	5.9	2760	H	>500	H	L	366	VH	560	H	Medium	H	H	H	H
11	9G	5.4	2300	H	>500	H	L	407	VH	560	H	Medium	H	H	H	H

Levels
VL = Very Low
L = Low
M = Medium
H = High
VH = Very High

> Means "More Than"

*The values for pounds per acre is based on testing procedures used at Texas A&M soil testing laboratories and may differ from results obtained by other procedures. The level of very low, low, etc., is more important than pounds per acre, since these levels indicate the probability of response to added plant nutrients.

SUGGESTED FERTILIZATION AND LIMING RATES

(Please read back side of report and the enclosed leaflet.)

Sample no.	Crop	Limestone	Total plant nutrients per acre			When to apply	REMARKS
		tons/A	lb. N	lb. P_2O_5	lb. K_2O		
All greens	Grass		See remarks				Several points are clear from these results. First the pH is lower than desirable except for sample 1 and Pat. Consideration of adding some ground limestone may be necessary if the pH drops further. We also find a moderate salinity hazard or soluble salts. This means that fertilization practices should be based on the use of low salt residue materials such as ammonium nitrate. It would appear that nitrogen fertilization would be the major requirement for the remainder of this year. See suggested fertilization in B-1129 attached. You will want to determine the source of salt if this is not already known. Water used to irrigate may contain salt and the amounts may increase.

If you have questions about this soil test report, see Mr. Melvin Wilson, your county agricultural agent, who is located in Robstown

(2)

NAME: Gregg, David WELL DEPTH: ______ Ft.

Box 8809 78412

TOWN: Padre Island Texas DATE: 4/6/72

COUNTY: NUECES

CALCIUM: 128 ppm as Ca

MAGNESIUM: 126 ppm as Mg

SODIUM: 1017 ppm as Na

BICARBONATES: 110 ppm as HCO_3

CHLORIDES: 1560 ppm as Cl

SULFATES: 226 ppm as SO_4

TOTAL SOLUBLE SALTS: 3567 ppm

TOTAL HARDNESS: 840 ppm as $CaCO_3$

SODIUM PERCENTAGE: 72.5 %

Ph: 8.6

Irrigation Pump Only

REMARKS

P.O. Box 8809 (7841

Padre Island
Country Club -

Phone - 933-805

CENTRAL POWER AND LIGHT COMPANY
REPORT OF WATER ANALYSIS

Name David Gregg (Irrigation Pump) Date of Test 11-28-72

Address Padre Island Country Club Depth of Well approx. 12'

Calcium 142 ppm as Ca Bicarbonates 268 ppm as HCO_3

Magnesium 112 ppm as MG Chlorides 1370 ppm as Cl

Sodium, Potassium 768 ppm as NA Sulfates 322 ppm as SO_4

Total Soluble Salts 2982 ppm

Total Hardness 816 ppm as $CaCO_3$

Sodium Percentage 67.2 % pH 7.7

REMARKS: For more information contact:

Richard Byrne

PO Box 1670

Alice, Tx. Phone # 664-5451

CENTRAL POWER AND LIGHT COMPANY
REPORT OF WATER ANALYSIS

Name David Gregg (Well Point System) Date of Test 11-28-72
Address Padre Island Country Club Depth of Well approx. 15'

Calcium 146 ppm as Ca
Bicarbonates 281 ppm as HCO_3
Magnesium 116 ppm as MC
Chlorides 1390 ppm as Cl
Sodium, Potassium 782 ppm as NA
Sulfates 334 ppm as SO_4
Total Soluble Salts 3051 ppm
Total Hardness 840 ppm as $CaCO_3$
Sodium Percentage 66.9 % pH 7.7

REMARKS: For more information contact:
Richard Beyrne
P.O. Box 1670
Alice, Tx. Phone #664-5451

APPENDIX III

WATER QUALITY TESTING REPORTS

CLEMENT O. WILLIAMS, JR. P. E.
CONSULTING ENGINEER

QUALITY
TESTING

622 FURMAN AVENUE
P. O. BOX 3371
CORPUS CHRISTI, TEXAS
78404
512 882-2494

March 1, 1973
(Date)

For: Padre Island Investment Corp. Job No.: QT 40-1

P. O. Box 8809, Corpus Christi, Texas 78412

Subject: Results of Tests Made During the Period February 1 to February 28.

	Sample Date	B.O.D.5 (mg/l)	C.O.D. (mg/l)	T.S.S. (mg/l)	Volatile S.S. (mg/l)	Total Residue * (mg/l)	Chlorides CL ~~XX~~ mg/L	Temp (°F)
1	2/14	7	-	30	-	28,800	-	-
2	2/14	6	-	20	-	31,800	-	-
	2/14	6	-	9	-	30,500	-	-
	2/14	18	-	82	-	3,610	-	-
5	2/20	-	-	-	-	-	1426	-

* Total Dissolved Solids

1 Unit 4
Packery Channel
3 Galeon Bay
Galeon Bay well point. Sample not submitted.

#5 Golf Course well point
#6 Golf Course lake

CLEMENT O. WILLIAMS, JR. P. E.
CONSULTING ENGINEER

QUALITY TESTING

622 FURMAN AVENUE
P. O. BOX 3671
CORPUS CHRISTI, TEXAS
78404
512 882-2494

April 2, 1973
(Date)

For: Padre Island Investment Corp. Job No.: QT 40-1
P.O. Box 8709 Corpus Christi, Texas 78412

Subject: Results of Tests Made During the Period March 1 to March 31.

	Sample Date	B.O.D.₅ (mg/l)	C.O.D. (mg/l)	T.S.S. (mg/l)	Volatile S.S. (mg/l)	Total Residue * (mg/l)	Chloride ~~pH~~ mg/l	Temp (°F)
#1	3/23	5	-	21	-	26,200	-	-
#2	3/23	7	-	8	-	29,200	-	-
3	3/23	6	-	12	-	28,800	-	-
#6	3/23	29	-	92	-	3520		-
#4							*	
#5							*	

* Total Dissolved Solids

#1 Unit 4
#2 Packery Channel
#3 Galeon Bay
#4 Galeon Bay Well Point
#5 Golf Course Well Point
#6 Golf Course lake

* Samples not submitted

CLEMENT O. WILLIAMS, JR. P. E.
CONSULTING ENGINEER

QUALITY
TESTING

622 FURMAN AVENUE
P. O. BOX 3671
CORPUS CHRISTI, TEXAS
78404
512 882-2494

May 7, 1973
(Date)

For: Padre Island Investment Corp. Job No.: QT 40-1

P.O. Box 8709 Corpus Christi, Texas 78412

Subject: Results of Tests Made During the Period April 1 to April 30

	Sample Date	B.O.D.$_5$ (mg/l)	C.O.D. (mg/l)	T.S.S. (mg/l)	Volatile S.S. (mg/l)	Total Residue * (mg/l)	Chloride ~~pH~~ (mg/l)	Temp (°F)
#1	4/26	4	-	18	-	-	-	-
#2	4/26	5	-	15	-	-	-	-
#3	4/26	3	-	20	-	-	-	-
#4	4/5	-	-	-	-	-	<25	-
#5	4/5	-	-	-	-	-	1410	-
#6	4/5	-	-	-	-	-	1196	-
#7	4/5	-	-	-	-	-	10,060	-
#8	4/5	-	-	-	-	-	7,559	
#9	4/5	-	-	-	-	-	7,270	
#10	4/5	-	-	-	-	-	2,846	
#6	4/26	17	-	99	-	-	-	-

* Total Dissolved Solids

#1 Unit 4
#2 Packery Channel
#3 Galeon Bay
#4 Galeon Bay Well Point
#5 Golf Course Well Point
#6 Golf Course Lake
#7 Blk. 239 Lot 4 North Section 4
#8 Blk. 235-21
#9 Blk. 226-36
#10 Golf Course Irr. Lake

GULF COAST
TESTING LABORATORY, INC.
- QUALITY TESTING COMPANY

CHEMICAL • PHYSICAL
ENVIRONMENTAL

ATOMIC ABSORPTION
SPECTROPHOTOMETRY

1205 NORTH TANCAHUA ST.
P. O. BOX 2466
CORPUS CHRISTI, TEXAS
78403
512 882-5411
512 883-3091

PRINCIPALS:
CLEMENT D. WILLIAMS, JR. P.E.

LABORATORY DIRECTOR:
JERRY O'DONNELL, PH.D

22 May, 1973
(Date)

For: Padre Island Investment Corp. Job No:

Subject: Results of Tests Made on Samples Received May 18, 1973

SAMPLE	TOTAL DISSOLVED SOLIDS (mg/1)	Na (mg/1)	Ca (mg/1)	Mg (mg/1)	Cl (mg/1)	SODIUM ABSOR RATIO
Galleon Bay Test # 3 N. End Blk. 74	68,900	32,200	520	4150	36,500	102.6
Galleon Bay Test # 2 Bulkhead + 50'	55,000	22,600	200	2620	30,200	90.2
Galleon Bay Test # 1 S. End Blk. 74	53,000	22,100	220	2480	28,800	76.9
Well Point # 1	36,000	12,500	820	1280	19,900	63.6
Well Point # 2	28,000	7,310	820	1380	17,700	36.3
Well Point # 3	17,500	4,940	300	760	11,900	34.5
* Well Point # 4	585	66	44	26	25	1.94
* Well Point # 5	3,087	730	92	124	1395	11.7
Section 4 Approx. 200' W of # 3	20,000	5410	170	780	12,700	38.9

* Samples Received May 16, 1973

CLEMENT O. WILLIAMS, JR. P. E.
CONSULTING ENGINEER

QUALITY TESTING

622 FURMAN AVENUE
P. O. BOX 3671
CORPUS CHRISTI, TEXAS
78404
512 882-2494

July 9, 1973
(Date)

For: Padre Island Investment Corp. Job No.: QT 40-1

P. O. Box 8709 Corpus Christi, Texas

Subject: Results of Tests Made During the Period June 1 to June 30

mple	Sample Date	B.O.D.$_5$ (mg/l)	C.O.D. (mg/l)	T.S.S. (mg/l)	Volatile S.S. (mg/l)	Total Residue * (mg/l)	pH	Temp (°F)
	6/15	9	-	51	-	29,100	-	-
	6/15	8	-	20	-	31,200	-	-
	6/8	8	-	23	-	30,200	-	-
	-	-	-	-	-	*	*	-
	-	-	-	-	-	*	*	-
	6/8	25	-	124	-	3,200	-	-

* Total Dissolved Solids

1 Unit 4
2 Packery Channel
3 Caloon Bay
* 4 Caloon Bay Wellpoint - Sample not received.
* 5 Golf Course Wellpoint - Sample not received.
6 Golf Course Lake

CLEMENT O. WILLIAMS, JR. P. E.
CONSULTING ENGINEER

1205 N. TANCAHUA
P. O. BOX 3671
CORPUS CHRISTI, TEXAS
78404
512 882-2494

QUALITY TESTING

July 26, 1973
(Date)

For: Padre Island Investment Corp. Job No: QT 40-1

P. O. Box 8709 Corpus Christi, Texas

Subject: Results of Tests Made During the Period July 1 to July 31

Sample No.	Sample Date	B.O.D.5 (mg/l)	T.S.S. (mg/l)	Total Dissolved Solids	Na (mg/l)	Ca (mg/l)	Mg (mg/l)	Cl (mg/l)	NAR
1	7/19	6	31	31,200	-	-	-	-	-
2	7/19	10	20	31,200	-	-	-	-	-
3	7/19	3	19	34,800	-	-	-	-	-
4	7/19	-	-	582	60	56	28	<25	1.6
5	7/19	-	-	3,030	610	100	114	1290	9.9
6	7/19	35	145	2,450	-	-	-	-	-
7	7/19	-	-	-	-	-	-	618	-
8	7/19	-	-	-	-	-	-	601	-

1. Unit 4
2. Packery Channel
3. Galeon Bay
4. Galeon Bay Wellpoint [illegible]
5. Golf Course Wellpoint
6. Golf Course Lake
7. Packery Channel sewage treatment pla
8. Galeon Bay sewage treatment plant

R. Bacon

CLEMENT D. WILLIAMS, JR. P. E.
CONSULTING ENGINEER

QUALITY
TESTING

622 FURMAN AVENUE
P. O. BOX 3671
CORPUS CHRISTI, TEXAS
78404
512 882-2494

August 28, 1973
(Date)

For: Padre Island Investment Corp. Job No: QT 40-1

Subject: Results of Tests Made During the Period August 1 to August 22

Sample No.	Sample Date	B.O.D.5 (mg/l)	T.S.S. (mg/l)	Total Dissolved Solids	Na (mg/l)	Ca (mg/l)	Mg (mg/l)	Cl (mg/l)	SAR
1	8/16	3	36	31,700	-	-	-	-	-
2	8/16	3	59	35,900	-	-	-	-	-
3	8/16	2	14	30,200	-	-	-	-	-
4**	8/8	-	-	964	172	67	27	322	4.5
4	8/22	-	-	572	58	54	27	147	1.6
4*	8/22	-	-	576	57	54	29	135	1.6
5	8/8	-	-	3000	620	104	118	1390	9.9
5	8/22	-	-	2940	560	101	114	1306	9.0
6	8/16	34	68	3170	-	-	-	-	-
6	8/8	-	-	3050	650	107	88	1490	11.2
6	8/22	-	-	2530	540	83	78	1213	10.2
7	8/22	-	-	-	-	-	-	296	-
8	8/22	-	-	-	-	-	-	135	-
9	8/22	-	6	-	-	-	-	-	-

1. Unit 4
2. Packery Channel
3. Galeon Bay
4. Galeon Bay Wellpoint
5. Golf Course Wellpoint
6. Golf Couse Lake
7. Packery Channel sewage treatment
8. Galeon Bay sewage treatment plant
9. Pump sample

Rhonda Bacon

* Old Sample
** Sample appears to be contaminated with a small amount of sea water

CLEMENT O. WILLIAMS, JR. P. E.
CONSULTING ENGINEER

QUALITY
TESTING

622 FURMAN AVENUE
P. O. BOX 3671
CORPUS CHRISTI, TEXAS
78404
512 882-2494

October 15, 1973
(Date)

For: Padre Island Investment Corporation Job No.: QT 40-1

P. O. Box 8709 Corpus Christi, Texas

Subject: Results of Tests Made During the Period Sept. 1, 1973 to Sept. 30, 1973.

ple	Sample Date	B.O.D.$_5$ (mg/l)	T.S.S. (mg/l)	Dissolved Solids (mg/l)	Na (mg/l)	Ca (mg/l)	Mg (mg/l)	Cl (mg/l)	S
1	9/24	7	19	27,100	-	-	-	-	
2	9/24	4	33	28,000	-	-	-	-	
3	9/24	3	22	29,600	-	-	-	-	
		-	-	-	-	-	-	-	
5	9/24	-	-	2,990	650	86	116	1395	1
6	9/24	11	36	1,840	380	56	68	859	
7	9/24	-	6	2,630	570	83	97	1193	1

* Total Dissolved Solids

#1 Unit #4
#2 Packery Channel
#3 Galeon Bay
#4 Galeon Bay Wellpoint - Sample not submitted
#5 Golf Course Wellpoint
#6 Golf Course Lake
#7 Irrigation Pump

Rhonda Bacon

CLEMENT O. WILLIAMS, JR. P. E.
CONSULTING ENGINEER

TESTING

622 FURMAN AVENUE
P. O. BOX 3671
CORPUS CHRISTI, TEXAS
78404
512 882-2494

November 5, 1973
(Date)

For: Padre Island Ivestement Corporation Job No.: QT 40-1
P. O. Box 8709 Corpus Christi, Texas

Subject: Results of Tests Made During the Period Oct. 1, 1973 to Oct. 31, 1973.

mple #	Sample Date	B.O.D.$_5$ (mg/l)	C.O.D. (mg/l)	T.S.S. (mg/l)	Volatile S.S. (mg/l)	Total Residue * (mg/l)	pH	Temp (°F)
1	10/22	6	-	15	-	13,400	-	-
2	10/22	3	-	16	-	10,800	-	-
3	10/22	3	-	20	-	20,400	-	-
5	10/22	9	-	20	-	548	-	-

* Total Dissolved Solids

Unit #4
Packery Channel
Galeon Bay
Galeon Bay Wellpoint - Sample not submitted
Golf Course Wellpoint - Sample not submitted
Golf Course Lake

Rhonda Bac

CLEMENT O. WILLIAMS, JR. P. E.
CONSULTING ENGINEER

QUALITY
TESTING

1205 N. TANCAHUA
P. O. BOX 3671
CORPUS CHRISTI, TEXAS
78404
512 882-2494

November 21, 1973
(Date)

For: Padre Island Investment Corp. Job No: QT 40-1

P. O. Box 8709 Corpus Christi, Texas

Subject: Results of Tests Made During the Period Nov. 1, 1973 to Nov. 30, 1973.

le	Sample Date	B.O.D.$_5$ (mg/l)	T.S.S. (mg/l)	Dissolved Solids (mg/l)	Na (mg/l)	Ca (mg/l)	Mg (mg/l)	Cl (mg/l)	SAR
	11/1	-	-	2910	700	100	116	1530	11.2
	11/6	-	-	1460	340	50	52	784	8.0
	11/13	5	21	13,400	-	-	-	-	-
	11/13	7	35	19,300	-	-	-	-	-
	11/13	4	14	21,100	-	-	-	-	-
	11/13	10	25	1970	-	-	-	-	-

1 Unit 4
2 Packery Channel
3 Galeon Bay
4 Galeon Bay Wellpoint - Not submitted
5 Golf Course Wellpoint
6 Golf Course lake

Rhonda Bacon

CLEMENT O. WILLIAMS, JR. P. E.
CONSULTING ENGINEER

QUALITY
TESTING

1205 N. TANCAHUA
P. O. BOX 3671
CORPUS CHRISTI, TEXAS
78404
512 882-2494

January 8, 1974
(DATE)

FOR: Padre Island Investment Corp. JOB NO: QT 40-1

P.O. Box 8709 Corpus Christi, Texas

Subject: Results of Tests Made During the Period Dec. 1, 1973 to Dec. 31, 1973.

mple #	Sample Date	B.O.D.$_5$ (mg/l)	T.S.S. (mg/l)	Dissolved Solids (mg/l)	Na (mg/l)	Ca (mg/l)	Mg (mg/l)	Cl (mg/l)
1	12/6	5	26	13,800	-	-	-	-
2	12/6	5	18	23,700	-	-	-	-
3	12/6	4	25	25,000	-	-	-	-
6	12/6	7	30	2,860	640	103	110	1510
4	12/5	-	-	647	68	62	29	179
	12/5	-	-	3,010	680	105	114	1530

1	Unit 4
2	Packery Channel
3	Galeon Bay
4	Galeon Bay Wellpoint
5	Golf Course Wellpoint
6	Golf Course Lak

Rhonda Bacon

CLEMENT D. WILLIAMS, JR. P. E.
CONSULTING ENGINEER

QUALITY
TESTING

1205 N. TANCAHL
P. O. BOX 3671
CORPUS CHRISTI, TE
78404
512 882-2494

February 13, 1974

For: Padre Island Investment Corp. Job No.: QT 40-1

P. O. Box 8709 Corpus Christi, Texas

Subject: Results of Tests Made During the Period Jan. 1, 1974 to Jan. 31, 1974

Sample #	Sample Date	B.O.D.$_5$ (mg/l)	T.S.S. (mg/l)	Dissolved Solids (mg/l)	Na (mg/l)	Ca (mg/l)	Mg (mg/l)	Cl (mg/l)	SAR
1	1/31	6	35	26,700	-	-	-	-	-
2	1/31	6	27	29,300	-	-	-	-	-
3	1/31	4	27	27,500	-	-	-	-	-
4	1/31		-	602	62	58	28	157	1.9
5	1/31		-	3,100	600	103	108	1320	9.8
6	1/31	13	35	3,170	620	93	106	1360	10.4

Rhonda Bacon

1 Unit 4
2 Packery Channel
3 Galeon Bay
4 Galeon Bay Wellpoint
5 Golf Course Wellpoint
6 Golf Course Lake

CLEMENT D. WILLIAMS, JR. P. E.
CONSULTING ENGINEER

QUALITY
TESTING

1205 N. TANCAHUA
P. O. BOX 3671
CORPUS CHRISTI, TEXAS
78404
512 882-2494

March 8, 1974
(Date)

For: Padre Island Investment Corp. Job No: QT 40-1

P. O. Box 8709 Corpus Christi, Texas

Subject: Results of Tests Made During the Period Feb. 1, 1974 to Feb. 28, 1974

Sample #	Sample Date	B.O.D.$_5$ (mg/l)	T.S.S. (mg/l)	Dissolved Solids (mg/l)	Na (mg/l)	Ca (mg/l)	Mg (mg/l)	Cl (mg/l)
1	2/26	5	32	24,100	-	-	-	-
2	2/26	5	46	31,500	-	-	-	-
3	2/26	3	35	30,300	-	-	-	-
4	2/18	-	-	628	66	48	30	157
5	2/18	-	-	3,050	540	84	110	1,300
6	2/26	8	24	3,060	560	84	109	1,340

1 Unit 4
2 Packery Channel
3 Galeon Bay
4 Galeon Bay Wellpoint
5 Golf Course Wellpoint
6 Golf Course Lake

Rhonda Bacon

Jar
Greg

CLEMENT O. WILLIAMS, JR. P. E.
CONSULTING ENGINEER

QUALITY
TESTING

1205 N. TANCAHUA
P. O. BOX 3671
CORPUS CHRISTI, TEXAS
78404
512 882-2494

April 8, 1974
(Date)

For: Padre Island Investment Corp. Job No. QT 40-1

P.O. Box 8709 Corpus Christi, Texas

Subject: Results of Tests Made During The Period March 1, 1974 to March 31, 1974

Sample #	Sample Date	B.O.D.$_5$ mg/l	T.S.S. mg/l	Dissolved Solids mg/l	Na mg/l	Ca mg/l	Mg mg/l	Cl mg/l	SAR
1	3/28	6	37	25,000	---	---	---	---	---
2	3/28	6	37	31,000	---	---	---	---	---
	3/28	2	25	29,300	---	---	---	---	---
4	3/28	---	---	580	65	65	28	161	1.7
5	3/28	---	---	2880	520	125	102	1260	8.3
6	3/28	20	54	2730	480	100	88	1140	8.4

R Bacon

1 Unit 4
2 Packery Channel
3 Galeon Bay
4 Galeon Bay Wellpoint
5 Golf Course Wellpoint
6 Golf Course Lake

Water

CLEMENT O. WILLIAMS, JR. P. E.
CONSULTING ENGINEER

QUALITY
TESTING

1205 N. TANCAHUA
P. O. BOX 3671
CORPUS CHRISTI, TEXAS
78404
512 882-2494

May 8, 1974
(Date)

For: Padre Island Investment Corp. Job No. QT 40-1

P. O. Box 8709 Corpus Christi, Texas

Subject: Results of Tests Made During The Period April 1, 1974 to April 30, 1974

Sample #	Sample Date	B.O.D.$_5$ mg/1	T.S.S. mg/1	Dissolved Solids mg/1	Na mg/1	Ca mg/1	Mg mg/1	CT mg/1	SAR
1	4/17	5	45	28,000	-	-	-	-	-
2	4/17	4	38	31,000	-	-	-	-	-
3	4/17	4	36	32,000	-	-	-	-	-
4	4/30	-	-	650	62	45	22	169	1.9
5	4/30	-	-	1,360	250	53	37	555	6.4
6	4/17	11	40	1,070	180	50	24	404	5.2

1 Unit 4
2 Packery Channel
3 Galeon Bay
4 Galeon Bay Wellpoint
5 Golf Course Wellpoint
6 Golf Course Lake

Rhonda Bacon

CLEMENT D. WILLIAMS, JR. P. E.
CONSULTING ENGINEER

**QUALITY
TESTING**

1205 N. TANCAHUA
P. O. BOX 3671
CORPUS CHRISTI, TEXAS
78404
812 882-2494

June 6, 1974
(DATE)

FOR: Padre Island Investment Corp. JOB NO: QT-40-1

P. O. Box 8709 Corpus Christi, Texas

Subject: Results of Tests Made During the Period May 1, 1974 to May 31, 1974

Sample #	Sample Date	B.O.D.$_5$ mg/l	T.S.S. mg/l	Dissolved Solids mg/l	Na mg/l	Ca mg/l	Mg mg/l	Cl mg/l	SAR
1	5/14	10	34	33,000	-	-	-	-	-
2	5/14	7	39	34,000	-	-	-	-	-
3	5/14	3	22	30,500	-	-	-	-	-
4	5/17	-	-	660	70	66	24	160	1.8
5	5/17	-	-	3,030	600	100	112	1280	9.8
6	5/14	18	46	1,210	215	83	30	452	5.1
7	5/16	-	-	4,360	925	105	125	2070	14.4
7	5/24	-	-	4,430	925	95	118	2080	14.9

1 Unit 4
2 Packery Channel
3 Galeon Bay
4 Galeon Bay Wellpoint
5 Golf Course Wellpoint
6 Golf Course Lake
7 Nursery Lake

Rhonda Bacon

Unusual Water Test!

WILLIAMS & MILLER, INC.
CONSULTING ENGINEERS
1205 NORTH TANCAHUA STREET

CLEMENT C. WILLIAMS, JR., P.E.
RICHARD J. MILLER, P.E.

P. O. BOX 3671
CORPUS CHRISTI, TEXAS 78
512 882-2494

QUALITY TESTING

June 19, 1974
(DATE)

FOR: Padre Island Investment Corp. JOB NO: OT-40-1

P. O. Box 8709 Corpus Christi, Texas 78412

Subject: Results of Tests Made During the Period ________ to ________

Sample #	Sample Date	$B.O.D._5$ mg/l	T.S.S. mg/l	Dissolved Solids mg/l	Na mg/l	Ca mg/l	Mg mg/l	Cl mg/l
1	6/13	3	46	26,000	-	-	-	-
2	6/13	2	18	38,000	-	-	-	-
3	6/13	4	43	38,000	-	-	-	-
4	6/13	-	-	702	70	60	27	169
5	6/13	-	-	2,550	520	90	99	1075
6	6/13	17	32	1,060	180	60	32	399
7	6/13	-	-	4,410	980	89	123	2050

1 Unit 4
2 Packery Channel
3 Galeon Bay
4 Galeon Bay Wellpoint
5 Golf Course Wellpoint
6 Golf Course
7 Nursery Lake

Rhonda Bacon

CONSULTING ENGINEERS
1205 NORTH TANCAHUA STREET

MENT O. WILLIAMS, JR., P.E.
HARD J. MILLER, P.E.

P. O. BOX 3671
CORPUS CHRISTI, TEXAS 78404
512 882-2494

QUALITY TESTING

July 15, 1974
(DATE)

FOR: Padre Island Investment Corporation JOB NO: QT 40-1

P. O. Box 8809 Corpus Christi, Texas

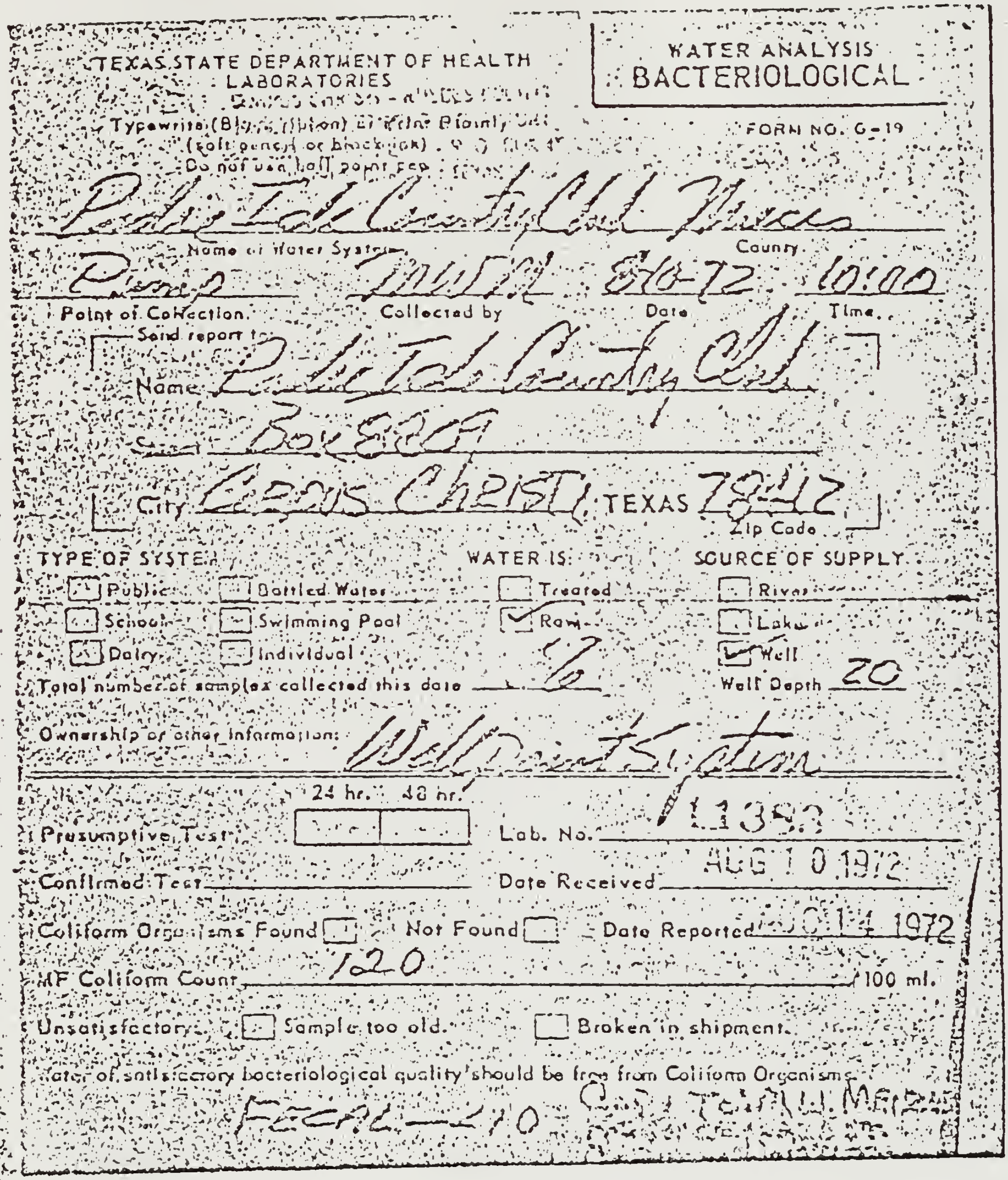
Subject: Results of Tests Made During the Period July 1, 1974 to July 31, 1974

Sample #	Sample Date	B.O.D.$_5$ mg/l	T.S.S. mg/l	Dissolved Solids mg/l	Na mg/l	Ca mg/l	Mg mg/l	Cl mg/l	SA
1	7/9	5	51	37,500	-	-	-	-	-
2	7/9	4	36	40,000	-	-	-	-	-
3	7/9	4	38	41,000	-	-	-	-	-
4	7/9	-	-	650	73	70	29	166	1
5	7/9	-	-	2,990	610	108	114	1230	9
6	7/9	34	174	1,910	380	95	43	787	8
7	7/9	-	-	4,580	1050	100	128	2130	16

1 Unit 4
2 Packery Channel
3 Galeon Bay
4 Galeon Bay Wellpoint
5 Golf Course Wellpoint
6 Golf Course Lake
7 Nursery Lake

Rhonda Bacon

CIVIL • MECHANICAL • ELECTRICAL • ENVIRONMENTAL • SANITARY • MUNICIPAL
CONSTRUCTION MANAGEMENT & SURVEILLANCE • FORENSIC



TEXAS STATE DEPARTMENT OF HEALTH
LABORATORIES

Typewrite (Black ribbon) or Write Plainly with
(soft pencil or black ink)
Do not use ball point pen

WATER ANALYSIS
BACTERIOLOGICAL

FORM NO. G-19

Padre Isle Country Club — Nueces
Name of Water System — County

Pump — [illegible] — 8-10-72 — 10:00
Point of Collection — Collected by — Date — Time

Send report to:
Name: Padre Isle Country Club
Box 8CA
City: CORPUS CHRISTI, TEXAS 78412
Zip Code

TYPE OF SYSTEM		WATER IS:	SOURCE OF SUPPLY
☐ Public	☐ Bottled Water	☐ Treated	☐ River
☐ School	☐ Swimming Pool	☑ Raw	☐ Lake
☐ Dairy	☐ Individual		☑ Well

Total number of samples collected this date 6 — Well Depth 20

Ownership or other information: Well Point System

	24 hr.	48 hr.
Presumptive Test		

Lab. No. L1393

Confirmed Test

Date Received AUG 10 1972

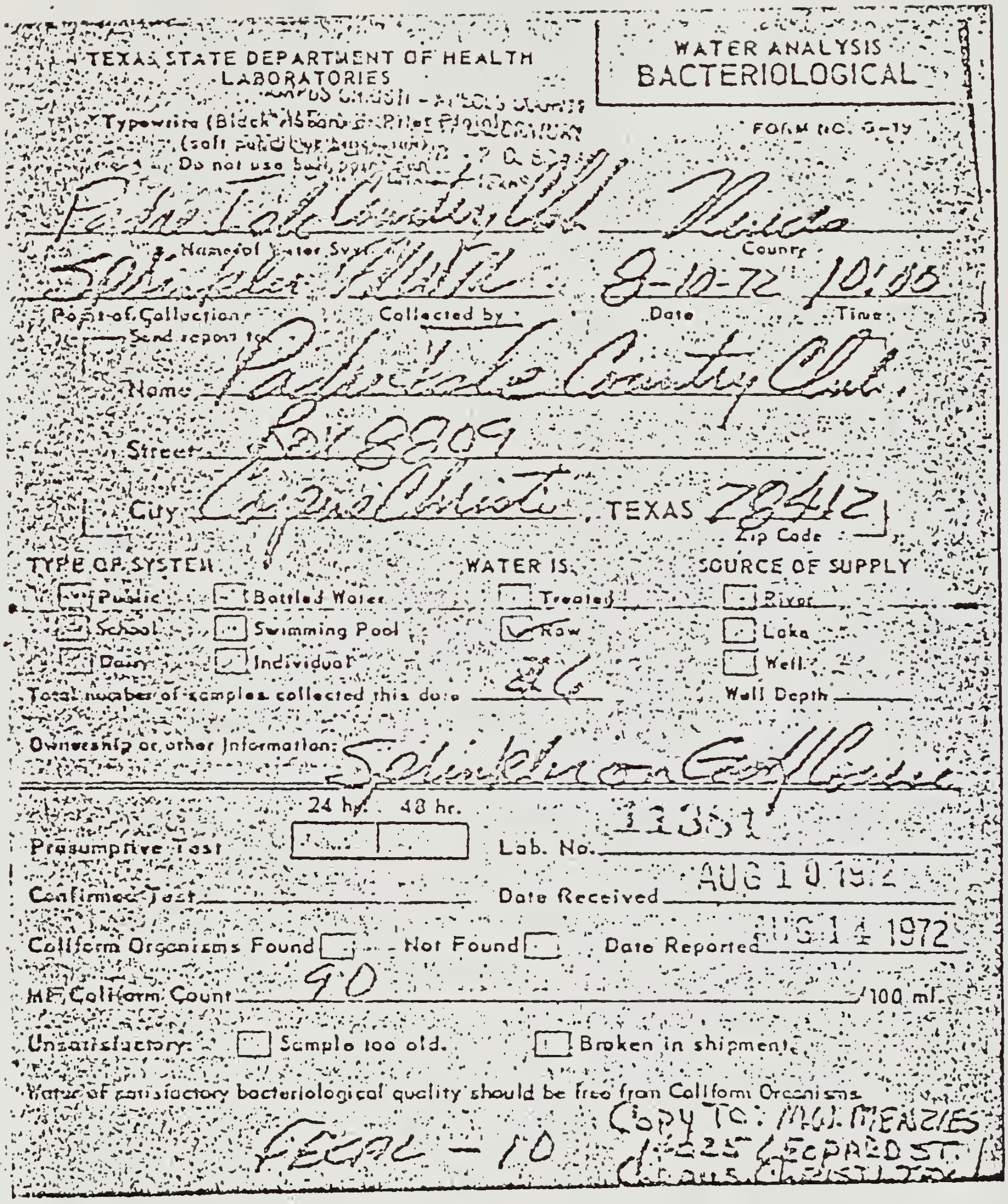
Coliform Organisms Found ☐ Not Found ☐ Date Reported AUG 14 1972

MF Coliform Count 120 /100 ml.

Unsatisfactory: ☐ Sample too old. ☐ Broken in shipment.

Water of satisfactory bacteriological quality should be free from Coliform Organisms.

FECAL—210



TEXAS STATE DEPARTMENT OF HEALTH
LABORATORIES

WATER ANALYSIS
BACTERIOLOGICAL

FORM NO. G-19

Typewrite (Black Ribbon) or Print Plainly
(soft pencil or ink)
Do not use ball point pen

Padre Isle Country Club — Nueces
Name of Water System — County

Sprinkler [illegible] — 8-10-72 — 10:05
Point of Collection — Collected by — Date — Time

Send report to:
Name Padre Isle Country Club
Street Box 8809
City Corpus Christi, TEXAS 78412
Zip Code

TYPE OF SYSTEM
☐ Public ☐ Bottled Water
☐ School ☐ Swimming Pool
☐ Dairy ☐ Individual

WATER IS
☐ Treated
☑ Raw

SOURCE OF SUPPLY
☐ River
☐ Lake
☐ Well

Total number of samples collected this date 26

Well Depth

Ownership or other Information: Sprinkler on Golf [illegible]

Presumptive Test — 24 hr. ☐ 48 hr. ☐

Lab. No. 11381

Confirmed Test

Date Received AUG 10 1972

Coliform Organisms Found ☐ Not Found ☐

Date Reported AUG 14 1972

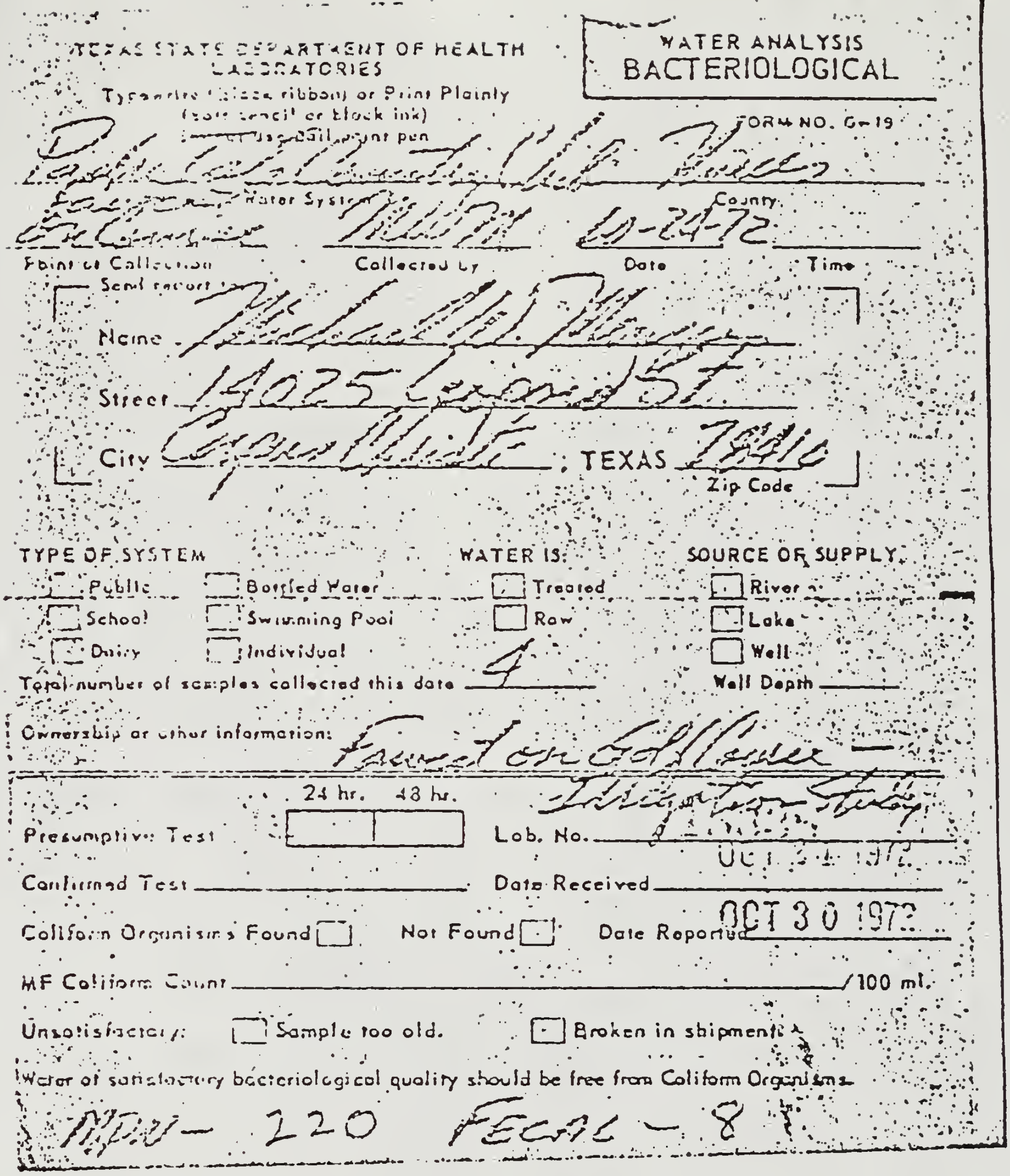
MF Coliform Count 90 /100 ml.

Unsatisfactory: ☐ Sample too old. ☐ Broken in shipment.

Water of satisfactory bacteriological quality should be free from Coliform Organisms.

FECAL – 10

Copy To: MAJ. MENZIES
4225 LEOPARD ST.
CORPUS CHRISTI, TEX.



TEXAS STATE DEPARTMENT OF HEALTH
LABORATORIES

Typewrite (black ribbon) or Print Plainly
(soft pencil or black ink)
or use ball point pen

WATER ANALYSIS
BACTERIOLOGICAL

FORM NO. G-19

[illegible] Country Club Nueces
Water System — County

[illegible] [illegible] 10-24-72
Point of Collection — Collected by — Date — Time

Send report to:
Name [illegible]
Street 14025 Leopard St.
City Corpus Christi, TEXAS 78410
Zip Code

TYPE OF SYSTEM
☐ Public ☐ Bottled Water
☐ School ☐ Swimming Pool
☐ Dairy ☐ Individual

WATER IS:
☐ Treated
☐ Raw

SOURCE OF SUPPLY:
☐ River
☐ Lake
☐ Well

Total number of samples collected this date 4

Well Depth

Ownership or other information: Faucet on Golf Course

Irrigation Study

	24 hr.	48 hr.
Presumptive Test		

Lab. No. [illegible]

Confirmed Test

Date Received OCT 24 1972

Coliform Organisms Found ☐ Not Found ☐ Date Reported OCT 30 1972

MF Coliform Count /100 ml.

Unsatisfactory: ☐ Sample too old. ☐ Broken in shipment.

Water of satisfactory bacteriological quality should be free from Coliform Organisms.

MPN – 220 FECAL – 8